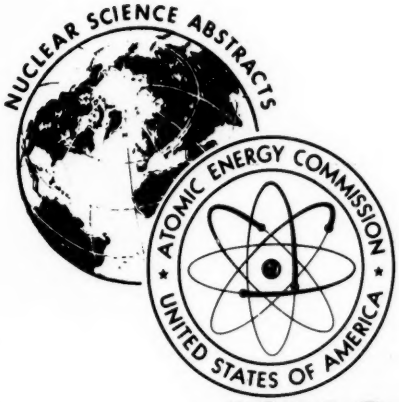

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NUCLEAR SCIENCE ABSTRACTS

Volume 20 Number 6

Abstracts 8504–10502

March 31, 1966

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NOTICE

A title page for Volume 20, Numbers 1–6, is included at the back of this issue for use in binding the first quarter of this volume.

CORRECTIONS

Vol. 18, No. 3, Abst. No. 4122, line 3 ... Should read ... Butsuri, 32: 391-7(June 1963). (In Japanese).

Vol. 18, No. 15, Abst. No. 25670, line 3 ... Should read ... Termotecnica (Milan), 17: 734-8(1963). (In Italian).

Vol. 18, No. 23, Abst. No. 41308, lines 3-6 ... Should read ... A. A. Balandin, V. I. Spitsyn, N. P. Dobrosel'skaya, and I. E. Mikhailenko. Translated by A. L. Monks (Oak Ridge National Lab., Tenn.), from Izv. Akad. Nauk SSSR, Ser. Khim., 379-82(1964). 4p.

Vol. 18, No. 23, Abst. No. 41774, line 3 ... Should read ... DETECTORS. Semi-Annual Report. Gerald C. Huth (General

Vol. 18, No. 23, Abst. No. 41920, lines 5-6 ... Should read ... International Conference on Diffusion in Body-Centered Cubic Materials, Gatlinburg, Tenn., Sept. 16-18, 1964.

Vol. 19, No. 7, Abst. No. 11820, lines 4-5 ... Should read ... 21p. (CONF-640624-1). American Meteorological Society 230th. National Meeting, Vancouver, B. C., June 22-4, 1964.

Vol. 19, No. 18, Abst. No. 34241, line 5 ... Should read ... of Sciences, Estonian SSR). Radiats. Fiz. Akad. Nauk Latv. SSR, Inst. Fiz., No. 1, 35-45

Vol. 19, No. 23, Abst. No. 44353, lines 6-7 ... Should read ... from Inzh. Fiz. Zh. Akad. Nauk Belorussk, SSSR, 1: No. 9, 123-7(1958). 8p. Dep. mn; CFSTI $1.00 cy, $0.50

Vol. 19, No. 23, Abst. No. 45276, lines 9-13 ... Should read ... which collector electrodes are placed at 10-cm intervals, was used for the indirect determination of the short-lived rare gas isotopes ^{138}Xe, ^{139}Xe, ^{89}Kr, ^{90}Kr, ^{137}Xe, ^{91}Kr, ^{140}Xe, ^{92}Kr, ^{141}Xe, ^{143}Xe, ^{142}Xe, ^{93}Kr, and ^{94}Kr. The apparatus used for the determination

Vol. 19, No. 24, Abst. No. 46591, lines 3-4 ... Should read ... lated for Oak Ridge National Lab., Tenn. from Mineralog. Sb., L'vovsk. Geol. Obshchest. L'vovsk. Gos. Univ., No. 16, 328-32(1962)

Vol. 19, No. 24, Abst. No. 46730, lines 2-3 ... Should read ... FOR ATMOSPHERIC ELECTRICITY SOUNDINGS. Dolezalek, Hans. Translated by Marcel I. Weinreich (Sandia Corp.,

Vol. 19, No. 24, Abst. No. 47317, lines 3-4 ... Should read ... Okun, L. B. Translated by A. T. Sanders from ITEF-343. Dep. mn; CFSTI $1.00 cy,

Vol. 19, No. 24, Abst. No. 47600, lines 3-4 ... Should read ... Univ., China). Acta Phys. Sinica, 21: 1522-32(Aug. 1965). (In Chinese).

Vol. 19, No. 24, Abst. No. 47869, lines 3-4 ... Should read ... Translated from Oak Ridge National Lab., Tenn. from Genshiryoku Kogyo, No. 10: No. 3, 22-5(1964). 12p. Dep. mn; JCL

Vol. 20, No. 2, Abst. No. 1756, line 3 ... Should read ... Hochschule, Vienna). Atomkernenergie, 10: 269-72(July-

Vol. 20, No. 2, Abst. No. 1757, line 5 ... Should read ... Lufthygienne, Berlin). Atomkernenergie, 10: 304-6(July-

Vol. 20, No. 2, Abst. No. 1961, line 4 ... Should read ... Vienna). Atomkernenergie, 10: 264-8(July-Aug. 1965). (In

Vol. 20, No. 2, Abst. No. 1962, line 5 ... Should read ... Loo, P. Van. Atomkernenergie, 10: 301-3(July-Aug. 1965).

Vol. 20, No. 2, Abst. No. 2049, line 3 ... Should read ... (Univ., Freiburg, Switzerland). Atomkernenergie, 10: 295-

Vol. 20, No. 2, Abst. No. 2060, line 3 ... Should read ... schaft und Forsten, Kiel). Atomkernenergie, 10: 285-94

Vol. 20, No. 2, Abst. No. 2132, line 4 ... Should read ... Ambro, P.; Karzhavin, Yu. A.; Matyushin, V. T.; Matushin,

Vol. 20, No. 2, Abst. No. 2139, line 4 ... Should read ... Atomkernenergie, 10: 249-53(July-Aug. 1965). (In German).

Vol. 20, No. 2, Abst. No. 2140, line 4 ... Should read ... 10: 255-60(July-Aug. 1965). (In German).

Vol. 20, No. 2, Abst. No. 2364, line 4 ... Should read ... ergie, 10: 261-3(July-Aug. 1965). (In German).

Vol. 20, No. 2, Abst. No. 2944, line 4 ... Should read ... kernenergie, 10: 839-42(July-Aug. 1965). (In German).

Vol. 20, No. 2, Abst. No. 2945, line 3 ... Should read ... schule, Vienna). Atomkernenergie, 10: 243-6(July-Aug.

Vol. 20, No. 2, Abst. No. 2946, line 3 ... Should read ... schule, Vienna). Atomkernenergie, 10: 247-8(July-Aug.

Vol. 20, No. 2, Abst. No. 3033, line 3 ... Should read ... Giessen, Ger.). Atomkernenergie, 10: 307-10(July-Aug.

Vol. 20, No. 2, Abst. No. 3034, line 5 ... Should read ... Atomkernenergie, 10: 311-14(July-Aug. 1965). (In Ger-

Vol. 20, No. 2, Abst. No. 3327, line 3 ... Should read ... TORS. Thrun, E. Atomkernenergie, 10: 278-84(July-

Vol. 20, No. 2, Abst. No. 3552, line 4 ... Should read ... Atomkernenergie, 10: 273-7(July-Aug. 1965). (In German).

Volume 20, Number 6, March 31, 1966

NUCLEAR SCIENCE ABSTRACTS

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NUCLEAR SCIENCE ABSTRACTS

BIOLOGY AND MEDICINE

General

Refer also to abstracts 8727, 9327, 9328, and 9605.

8504 (BNWL-SA-417) BATTELLE-NORTHWEST SWINE RESEARCH FACILITIES. McClellan, R. O.; Horstman, V. G.; Clarke, W. J.; Bustad, L. K. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Nov. 17, 1965. Contract AT(45-1)-1830. 20p. (CONF-650718-4). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

From Symposium on Swine in Biomedical Research, Richland, Wash.

The research facilities used in studies with standard and miniature swine are described. Standard swine were most satisfactorily maintained on pasture or in larger dry lots, however, even under these conditions difficulties were encountered in maintaining animals for lifetime observation. Pitman-Moore miniature swine were successfully maintained in large inside pens without outside exercise space for over six years. Other miniature swine were successfully maintained in concrete floored outside pens for a number of years. The advantages and disadvantages of the various facilities used are discussed. (auth)

8505 (BNWL-SA-418) NUTRITIONAL EXPERIENCE WITH SWINE AT BATTELLE-NORTHWEST. Horstman, V. G.; McClellan, R. O.; Bustad, L. K. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Nov. 16, 1965. Contract AT(45-1)-1830. 9p. (CONF-650718-3). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

From Symposium on Swine in Biomedical Research, Richland, Wash.

A ration is described which has given satisfactory results for growth, maintenance, and reproduction when administered to miniature swine maintained indoors for up to 6 years. A limited dietary intake not to exceed 2 lbs/day is recommended. For producing young adult miniature swine for experimentation, another ration was developed which proved adequate when fed free choice. (auth)

8506 (CONF-727, pp 21-4) A PROGRESS REPORT ON RADIOLOGICAL CHEMISTRY AT HANFORD. Nielsen, J. M. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation).

Progress made in large area alpha spectrometry and ^{137}Cs determination in human hair is reported. (TCO)

8507 (COO-119-233, pp 88-93) DETERMINATION OF ^{90}Sr IN BIOLOGICAL MATERIAL WITH SOLVENT EXTRACTION OF ^{90}Y INTO SCINTILLATOR SOLUTION. Atherton, David R. (Utah Univ., Salt Lake City. Radiobiology Div.).

The general method of di(2-ethylhexyl)phosphoric acid (EHPA) extraction of yttrium has been adapted for the analysis of excreta, bone, and soft tissue samples containing ^{90}Sr. The feature of interest in the method is that the toluene used for dilution of the EHPA contains 2,5 diphenyloxazole (PPO) and 1,4 bis-2-(5 phenyloxazole) benzene (POPOP) which enables one to obtain count rates following extraction of the yttrium without further manipulation of the sample. Limit of the method is probably imposed by the counting system which in this laboratory permits the detection of 16 pC of ^{90}Y with an expected error of ±5% using 100 minute counting times. (auth)

8508 (EUR-2589.e) REPORT OF ACTIVITIES OF THE INTERNATIONAL LABORATORY OF GENETICS AND BIOPHYSICS, JULY 1, 1963-JUNE 30, 1964. (International Lab. of Genetics and Biophysics, Naples (Italy)). Aug. 16, 1965. 52p. Dep. mn.

Developments in studies on: genetics and biophysics of bacterial viruses; human, animal, and biochemical genetics; biochemistry of nucleic acids and the nervous system; radiobiology, genetics, and physiol gy of mammalian cells in culture; and oncogenic viruses are reported. (P.C.H.)

8509 (LF-28, pp 30-9) A PATHOLOGY REQUISITION-REPORT FORM FOR EXPERIMENTAL USE WITH COMPUTER CODING. Chiffelle, T. L.; Jones, R. K.; Scott, J. K. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.).

A combined requisition-report form was devised for general use in laboratories where tissues are submitted to a central pathology laboratory for evaluation. The form was designed to provide for convenience and simplicity in use. Coded information supplied on the form may be readily entered into computer storage. Printed anatomic drawings of soft tissues and the skeletal system accompanying the requisition-report form enhance accuracy of gross dissection observations. Sketches and specifications of lesions are made directly on the drawing. (P.C.H.)

8510 (LF-28, pp 51-72) DOG CARE PROGRAM. Redman, H. C.; Sherrod, J. H.; Jordan, W. F.; Pollock, N. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.).

Procedures and clinical tests used for the annual physical examination to assess the general health and care of breeding and puppy colonies are described. The examinations are performed on a routine schedule. (P.C.H.)

8511 (NYO-2280-6) HUMAN POPULATIONS. Cavalli-Sforza, L. L. (International Lab. of Genetics and Biophysics, Pavia (Italy). Pavia Univ. (Italy). Istituto di Genetica). [1965]. Contract AT(30-1)-2280. 41p. (CONF-650940-2). Dep. mn; CFSTI $2.00 cy, $0.50 mn.

From Genetics Society of America, Mendel Centennial Conference, Fort Collins, Colo.

Discussion is presented on mutation, selection, and genetic drift. The reconstruction of some events in human evolution, using genetic data and models, is considered. Consideration on a world basis of the standard polymorphism, such as for blood groups and serum proteins, shows that it is possible, on purely numerical grounds,

that drift may have played a substantial part in determining differences between ethnic groups. (P.C.H.)

8512 A MEGAKARYOCYTE-STIMULATING SUBSTANCE IN NORMAL HUMAN PLASMA. Steinberg, Bernhard; Cheng, Frank H. F. (Toledo Hospital, Ohio). Acta Haematol., 33: 86-96(1965).

A protein fraction was prepared from human plasma which increased the number of megakaryocytes in rabbit bone marrow. This is of interest to radiobiology in view of the known radioinduced depression of platelet formation. It was previously found that fractions associated with normal human serum albumin exerted varying effects on the composition of bone marrow and frequently on the cells in the peripheral blood of rabbits, but since a heterologous serum and multiple intravenous injections were used, toxicity and an antigen antibody reaction were two of the several problems which required evaluation. The toxicity of human serum for rabbits resulted in death of animals within several hours following intravenous injection of 2.2 ml/lb of body weight. This toxic effect was removed after 24 hr of dialysis of serum. A fractionation procedure for purification of the active principle is described. The active fraction obtained from normal human serum by separation with sodium tetrametaphosphate at pH of 4.4, at 23°C, and at a specific ionic strength was found to be composed of about 10% of total albumin and some globulins. Upon removal of the globulins and division of albumin by continuous flow electrophoresis, the part of albumin with greatest mobility was associated with hyperplasia of megakaryocytes in bone marrow of rabbits, which was not followed by an increase of circulating thrombocytes. On the basis of these observations and experiments, the stimulation of megakaryocytes in bone marrow of rabbits by multiple intravenous injections of a fraction of normal human serum may be considered a true hyperplasia. The association of hyperplasia with an electrophoretically highly mobile albumin component suggests that the albumin may serve as a carrier of the stimulant. (BBB)

8513 FACTORS IN NORMAL HUMAN SERUM AFFECTING PROLIFERATION AND MATURATION OF ERYTHROCYTES AND GRANULOCYTES. Steinberg, Bernhard; Cheng, Frank H. F.; Martin, Ruth A. (Toledo Hospital, Ohio). Acta Haematol., 33: 279-86(1965).

The concept of humoral factors which control and regulate the development and maturation of granulocytes and erythrocytes was evaluated. This concept is relevant to radiobiologic studies in view of the depression of hematopoiesis by ionizing irradiation. Several hematopoiesis-stimulating protein fractions were isolated from human serum by a method that is outlined. Their stimulation of bone marrow was tested. Normal human serum was fractionated with sodium tetrametaphosphate, composed of 2 to 5% α and 95 to 98% β type, at a specific temperature, pH, and ionic strength. Variation of pH and addition of serum to diluent resulted in 5 fractions. Two produced no effect on bone marrow or peripheral blood. One fraction stimulated production and maturation of granulocytes and erythrocytes in bone marrow which was reflected in the blood stream. Another fraction suppressed maturation of granulocytes. A third fraction suppressed maturation and decreased production of granulocytes and erythrocytes. A fourth fraction stimulated production of lymphocytes and produced hyperplasia of splenic follicles, but did not affect the bone marrow. It is postulated that these fractions may represent humoral factors concerned with regulation and control of granulocytes, erythrocytes, and possibly lymphocytes. Each cell type appears to be controlled by at least two factors. One stimulates and the other depresses production and maturation of cells. In this manner, a normal hemacytopoietic state is maintained in the bone marrow and the blood stream. (BBB)

8514 THROMBOCYTIC AND THROMBOPENIC FACTORS IN NORMAL HUMAN SERUM. Steinberg, Bernhard; Cheng, Frank H. F.; Martin, Ruth A.; Dietz, Albert A. (Toledo Hospital, Ohio). Acta Haematol., 33: 341-50 (1965).

Thrombocytopenia and the ensuing hemorrhagic diathesis are important factors in the radiation syndrome; therefore, the humoral regulation of thrombocytes is of radiobiologic significance. A previous report indicated the existence of a factor which stimulated the production of megakaryocytes without increasing thrombocytes. The present report suggests the presence of two distinct factors, one for megakaryocyte and another for thrombocyte control. These two substances were obtained by ammonium sulfate fractionation of normal human serum. One fraction increased thrombocytes in the blood of rabbits. Multiple injections sustained thrombocytosis. The second factor decreased thrombocytes in a repetitive pattern. Multiple injections sustained thrombopenia. Both substances were thermolabile at 90°C for one and thermostabile at 60°C for 30 min. Passive transfer showed their disappearance from circulation in 24 hr with stimulation of intrinsic thrombopoietic factors on the 5th day. It is postulated that control of the normal mechanism of thrombopoiesis includes at least 3 factors. One stimulates megakaryocyte proliferation, and another increases thrombocyte production in megakaryocytes. The third, a thrombopenic factor, controls the number of thrombocytes for physiological requirements. By the starch-gel electrophoresis method, it was possible to demonstrate specific proteins in the fractions. Bulk albumin and postalbumin were identified with the thrombocytic factor. (BBB)

8515 GASTRIC HYALINIZATION WITHOUT IRRADIATION. Smith, J. Chandler (Western Reserve Univ., Cleveland). Arch. Pathol., 81: 42-6(Jan. 1966).

Three cases of gastric hyalinization are reported in which there were no previous histories of irradiation or administration of radiomimetic drugs. The lesions were characterized by thickening and rigidity of the stomach wall, translucence of the cut surface, and atrophy of the mucosa with effacement of the rugal pattern. Patients both with and without malignant tumors were afflicted with the condition. (H.G.D.)

8516 THE USE OF RADIOISOTOPES IN DENTAL RESEARCH. Gillings, B. R. D. (Univ. of Sydney). At. Energy Austral., 8: 17-23(Oct. 1965).

The use of radioisotopes for measuring the rate of tooth enamel dissolution and for studying the dental effects of trace elements in food and drink, particularly the fluoride ion, is described. (L.B.S.)

8517 REDUCTION OF THE TOXICITY OF RADIOMIMETIC ALKYLATING AGENTS IN RATS BY THIOL PRETREATMENT. V. THE EFFECT OF THIOL PRETREATMENT ON THE ANTI-TUMOUR ACTION OF MEROPHAN. Connors, T. A.; Jenney, A. Jr.; Whisson, M. E. (Royal Cancer Hospital, London). Biochem. Pharmacol., 1681-3(Nov. 1965).

Neither cysteine nor AET increased the selectivity of action of merophan in rats bearing the Walker tumor, while in mice bearing a plasma cell tumor, AET enhanced the selectivity of action as measured by therapeutic index. Time of administration of the thiols was important in determining the relative protective action on the host and tumor, and was well correlated with time curves of SH concentration in the tissues. (auth)

8518 THE ACTION OF TWO SULFHYDRYL COMPOUNDS ON NORMAL HUMAN RED CELLS: RELATIONSHIP TO RED CELLS OF PAROXYSMAL NOCTURNAL HEMOGLOBINURIA. Sirchia, Girolamo; Ferrone, Soldano; Mercuriali, Francesco (Univ., Milan). Blood, 25: 502-10(Apr. 1965).

Treatment of erythrocytes with various agents confers upon them in vitro properties which resemble those red cells from patients with paroxysmal nocturnal hemoglobinuria (PNH). The action of two radioprotective agents in this regard was studied by treating normal human red cells with AET (2-amino-ethylisothiouronium bromide) and with cysteine; both substances contain SH groups, belong to the group of radioprotective sulfhydryl compounds, but are not enzymes in nature. The results showed that treatment of normal human red cells with AET or cysteine changes them

in such a way that their behavior in in vitro hemolysis tests is similar to that of PNH red cells. (TCO)

8519 FETAL LIVER SUSPENSIONS IN THE TREATMENT OF MARROW APLASIA. Bridges, J. B.; Bridges, J. M.; Edelstyn, G. J. A.; Lyons, A. R. (Queen's Univ., Belfast). Brit. J. Cancer, 19: 122-5(Mar. 1965).

Infusions of hematopoietic cells have now been widely used in the treatment of various forms of marrow failure, such as that resulting from whole-body irradiation. These cells have generally been obtained from an adult living donor or from the patient before either chemotherapy or radiotherapy for reinfusion after these procedures. An attempt was made to use fetal liver as a source of hematopoietic cells by giving infusions to 15 patients with severe marrow failure. The first of ten patients developed marrow failure following exposure to cytotoxic drugs; in a second group of five patients there was no known exposure to any toxic agent. In only three patients of the first group of ten did the pancytopenia eventually resolve and the level of circulating cells reach pretreatment levels. In the remaining seven cases there was no improvement in the pancytopenia before death 3 to 10 days following the fetal liver infusion. Of the three patients in whom the level of circulating cells reached pretreatment levels, in no case was there any evidence that the infused cells survived permanently. In two patients there was no evidence of any clinical, or of direct hematological, benefit from the infused cells, but in the remaining patient there was evidence that the infused cells survived, matured, and circulated for a short period. In this patient the improvement in the clinical and hematological findings was immediate and striking following the fetal liver infusion, and normal levels of circulating cells were attained within 30 days. (BBB)

8520 ON THE SUBJECT OF THE BRINGING INTO SERVICE OF AN APPLIED RADIO-BIOLOGY LABORATORY-FARM. Nizza, M. Bull. Inform. Sci. Tech. (Paris), No. 94, 77-80(June 1965). (In French).

Facilities at Jouy-en-Josas for radiobiological research using large animals such as pigs, sheep, and cattle are described. Emphasis at the laboratory is on research that can be extrapolated to human applications. (H.G.D.)

8521 CRYOPRESERVATION OF BONE MARROW WITH LOW MOLECULAR WEIGHT POLYVINYLPYRROLIDONE. Persidsky, M. D.; Richards, V.; Leef, J. (Presbyterian Medical Center, San Francisco). Cryobiology, 2: 74-8(1965).

The cryoprotective effectiveness of low molecular weight polyvinylpyrrolidone (PVP), K-15 and K-17, in the preservation of rat and mouse bone marrow was evaluated on the basis of tissue culture followed by phase contrast microscopy, by incorporation of glycine-^{14}C, and by the 30-day survival of lethally irradiated mice (800 R). The cell viability test, employing both tissue culture and incorporation of glycine-^{14}C, indicated that low molecular weight PVP is an effective protective agent in the cryopreservation of nucleated cells. Additional proof of the effectiveness of these additives, particularly PVP K-15, was shown by the experiments with lethally irradiated mice, which demonstrated that the repopulating potentials of frozen-thawed bone marrow remained close to those of fresh marrow. These results were obtained on the basis of a low cell number per injection (60,000 to 120,000) which provides a 50% effective cell dose. These low cell levels yield a better measure of cell viability, making the results from a 30-day survival of animals more quantitative. PVP K-15 was also proven more effective than K-30 in a previous study. The virtually complete renal excretion of PVP K-15 eliminates any concern as to its acceptability for human use. Therefore, it suggested that the effectiveness of low molecular weight PVP should be further tested in the preservation of human bone marrow. It appeared to be as effective as dimethyl sulfoxide in preliminary studies. (BBB)

8522 VARIOUS ASPECTS OF THE SECONDARY SYNDROME COMPLICATING THE ALLOGENIC TRANSFUSIONS OF BONE MARROW OR OF LEUKOCYTES IN THE CASE OF SUBJECTS AFFLICTED BY MALIGNANT HEMOPATHIES. Mathe, G. (Institut de Radiobiologie TNO, Rijswijk, Netherlands); Schwarzenberg, L.; de Vries, M. J.; Amiel, J. L.; Cattan, A.; Schneider, M.; Binet, J. L.; Tubiana, M.; Lalanne, C.; Schwarzmann, V.; Nordmann, R. Europ. J. Cancer, 1: 75-113(Oct. 1965). (In French).

Fourteen cases of secondary syndrome in man, complicating transfusions of allogeneic bone marrow after total irradiation at lethal dose, or transfusions of leukocytes, are analyzed. Clinical, hematological, histological, and biochemical injuries are described and compared with those observed in several animal species. Data collected in man indicate that the essential physiopathologic process is to be found in the reaction of the graft to the host, as is the case in the animal. The reaction, while unfavorable since it is the cause of the secondary syndrome, may nevertheless be used as immunotherapy in leukemia. The results obtained in this respect in three patients are encouraging; one of them, a total hematopoietic chimera (myeloid and lymphoid) showed a normal hematological picture after 20 months. Apparently complete remissions were obtained after leukocyte transfusions in 3 out of 6 patients with acute lymphoblastic leukemia. It is suggested that this antileukemic effect is also due to the reaction of the graft to the host. The value of the means used to control the secondary syndrome is analyzed: it seems that the use of multiple donors and of amethopterin after cell transfusions may be really effective. (TCO)

8523 THE MUTABILITY OF LOCI IN AN X-CHROMOSOME DUPLICATION OF DROSOPHILA MELANOGASTER. Watty, Frank J. (San Diego State Coll., Calif.). Genetics, 52: 1113-17(Dec. 1965).

Experiments were conducted to determine the effect of heterochromatic involvement and chromosome heterozygosity on the mutability of loci in a duplication of the w^+ and N^+ loci that is inserted in an autosome. The simultaneous occurrence of the w and N phenotype in the duplication is significantly more frequent than changes in and/or loss of the two loci individually. It is hypothesized that single breaks in the duplication may not restitute because of stress on the region and may be expressed as dominant lethals. Heterochromatic involvement of loci in the duplication may also be related to the higher rate of change of both loci simultaneously in the duplication. Pairing between the w-N region in the normal X chromosome and the duplication may account for an increased loss of the segment in postmeiotic cells. (auth)

8524 NON-UNIFORMITY OF RADIATION DOSE IN SPACE WITH SPECIAL REFERENCE TO RADIOLOGICAL PROTECTION. Vaughan, Janet (Bone-Seeking Isotopes Research Unit, Churchill Hospital, Oxford). Int. J. Radiat. Biol., 9: 513-43(1965).

The relationship of the terms: distribution factor, quality factor, and relative damage factor as used by I.C.R.P. is discussed. Existing data, quantitative and qualitative, on uneven distribution of internally deposited radioactive elements are reviewed together with data on the sites of sensitive tissue, i.e., tissue at particular carcinogenic risk. (auth)

8525 BONE MARROW TRANSPLANTATION IN MAN. Dameshek, William (Tufts Univ., Boston). Med. Times, 89: 139-44(Feb. 1961).

The experimental basis, technique, results, and problems of transplanting bone marrow in humans are discussed, particularly in relation to protection from otherwise lethal irradiation. Methods were developed for collection and storage of marrow. The technique is described whereby marrow is collected from the iliac crests through a large gauge needle, under local procaine anesthesia. The needle is angulated in various directions at various depths of iliac bone which contains a large marrow cavity, yielding 150 to 200 ml of marrow material from each iliac crest. Cell counts of the marrow material obtained from a single donor vary from eight to 20 billion. Preservation of marrow is also considered, and some indications for bone marrow

transplantation in man are enumerated. In autotransplantation, in which there is no rejection problem, reinfusion of stored marrow after deliberate massive radiotherapy or chemotherapy for malignant disease, including leukemia, is under consideration. Even though autotransplantation and perhaps even homotransplantation may occur, the eventual value of this is questionable, since as yet it has been impossible to destroy the malignant disease, such as leukemia or disseminated lymphosarcomatosis. Cases in which immunosuppressive agents were used along with transplantation are described. (TCO)

8526 ALLOGENEIC INHIBITION OF TUMOUR CELLS BY IN VITRO CONTACT WITH CELLS CONTAINING FOREIGN H-2 ANTIGENS. Hellstroem, K. E.; Hellstroem, I.; Bergheden, C. (Karolinska Institutet, Stockholm). Nature, 208: 458-60(Oct. 30, 1965).

A test was made of the hypothesis that allogenic inhibition in vitro might be due to the contact between the grafted tumor cells and the foreign isoantigens of the host. Neutralization experiments were made in which lymphoma cells were exposed in vitro to spleen or tumor cells, containing foreign H-2 antigens, and their outgrowth in syngenic hosts was measured after subsequent implantation. Also tissue culture experiments were performed, in which explanted tumor cells were followed for the development of cytopathic changes after exposure to lymphoma cells containing H-2 antigens of the syngenic or allogenic type. Various curves and tables are given showing the experimental results. It is suggested that allogenic inhibition may function as a surveillance mechanism capable of eliminating cellular variants, the (H-2) antigenicity of which differs from the general pattern within a given tissue, without necessary engagement of immunologically competent cells. (J.F.P.)

8527 NUCLEAR TECHNOLOGY IN AGRICULTURE. de Zeeuw, D. (EURATOM-ITAL, Wageningen, Netherlands). Neue Tech., 5: 238-44(1965).

Nuclear techniques used in agriculture are reviewed. The uses of nuclear techniques in breeding, pest control, food technology, and plant growth and development are summarized. (J.S.R.)

8528 EFFECT OF SOME METABOLITES AND ANTIMETABOLITES ON THE BREAKDOWN OF DEOXYRIBONUCLEIC ACID AND ON THE COLONY-FORMING ABILITY OF ESCHERICHIA COLI B AFTER GAMMA IRRADIATION. IV. SYNTHESIS OF NUCLEIC ACIDS AND PROTEIN AFTER RE OVAL OF THE AGENT THAT INHIBITS GAMMA-RAY-INDUCED DNA BREAKDOWN. Kos, E.; Drakulic, M.; Sasel, Lj. (Inst. Ruder Boskovic, Zagreb). Radiat. Res., 27: 10-18(Jan. 1966).

Biosynthesis of both types of nucleic acids and of proteins was studied when DNP was deleted from the acetate buffer during the 90 min of postirradiation incubation, and the microorganisms were reincubated in a mineral medium. After resuspension in the mineral medium, only a very small amount of DNA was slowly broken down. During reincubation the biosynthesis of DNA, RNA, and protein was very slow and limited in amount in comparison with the same biosynthetic processes going on in bacteria incubated in a mineral medium immediately after irradiation. (H.G.D.)

8529 STUDIES IN THE PRESERVATION OF BONE MARROW. Richards, Victor; Persidsky, Maxim (Presbyterian Medical Center, San Francisco). Surgery, 50: 288-398(July 1961).

Some problems of preservation of bone marrow cells by freezing were investigated employing microphotography and tissue cultures of frozen marrow with assessment of viability quantitatively under the phase-contrast microscope. Results were verified by experiments in which frozen isologous marrow was injected into lethally irradiated mice. Studies with rat bone marrow are also reported. The significance of freezing velocity was studied and it was found that a freezing velocity of 1 degree/sec in the temperature range of 0 to −27°C is optimal. The temperature at which ice formation is initiated was studied; the best temperature for initiation of ice formation was −5°C with the slow freezing process. Different protective substances were evaluated with respect to 15% glycerol as the control additive. Polyvinylpyrrolidone (PVP) with molecular weight 30,000 in 10% concentration was found to give superior results to 15% glycerol in the preservation of marrow. It is postulated that the mechanism of protection from freezing injury under PVP consists in coating of the cell with PVP, plugging the pores in the cell membrane, and preventing intracellular electrolyte concentration, ice formation, and excessive dehydration mechanisms whereby the cell is killed by freezing. (TCO)

8530 RELATIVE REJECTION EFFICIENCY OF HOMOGRAFTED ERYTHROPOIETIC CELLS IN MICE BY ISOLOGOUS IMMUNOCOMPETENT CELLS. Willard, H. G.; Smith, L. H. (Oak Ridge National Lab., Tenn.). Transplantation, 4: 56-65(Jan. 1966).

A method for determining immunological competence of mouse cells is described. This method is based on rejection of the erythropoietic component of homografted bone marrow by isologous cells. The extent of erythropoiesis was measured by spleen uptake of ^{59}Fe. On the basis of ability to reject homografted marrow, the following order of effectiveness was observed: leukocytes > lymph node cells > spleen cells > peritoneal fluid cells. Thymocytes and marrow cells showed no capacity for rejection. The immunological competence of cultured peripheral leukocytes declined rapidly so that at the end of 48 hr in vitro only 2.5% of the initial activity remained. (auth)

8531 INTERNATIONAL REVIEW OF CYTOLOGY. VOLUME 18. Bourne, G. H.; Danielli, J. F. (eds.). New York, Academic Press, 1965. 437p. $16.00.

The nine sections of this book discuss the nature and derivation of Langerhans cells of the epidermis, the structure of the mammalian egg, cytoplasmic inclusions in oogenesis, enzyme activity of subcellular fractions isolated by differential centrifuging of tissue homogenates, the histochemical localization of enzyme activities by substrate film methods, cytoplasmic desoxyribonucleic acid, malignant transformation of cells in vitro, deuterium isotope effects in cytology, and the use of heavy metal salts as electron stains. Each section is written by an author, or authors, who have a particular interest in the subject, and each section includes a comprehensive bibliography. Author and subject indexes are also included. (C.H.)

8532 OBSERVATIONS ON THE NATURE OF THE MITOTIC AND MEIOTIC ARREST INDUCED BY DEUTERIUM OXIDE IN TETRAHYMENA PYRIFORMIS [Thesis]. Brown, M. Jay. New York, New York Univ., 1963. 92p.

The literature on the chemistry and biology of deuterium oxide bearing on the deuterium oxide-induced arrest of mitosis is reviewed. Rates of enzyme-substrate reactions are altered in the presence of heavy water. The present research adds to existing data showing that at concentrations of D_2O just sufficient to block mitosis this effect is probably not of sufficient magnitude to explain the antimitotic action of heavy water, for Tetrahymena pyriformis were found to be able to maintain normal shape even in distilled water containing 60% D_2O, though 45% D_2O completely blocks cell division. This research also shows that derangement of the deoxyribonucleic acid (DNA) molecule and its enzymatic synthesis by changes in strength of hydrogen bonding induced by heavy water can also not fully account for mitotic arrest by heavy water for two reasons. First, heavy water blocks mitosis even when added after DNA synthesis is completed, as the second meiotic division in conjugating Tetrahymena is blocked by deuterium oxide added following the first meiotic division. Second, DNA synthesis was found to continue even in the presence of 60% heavy water. When tritiated thymidine is added to log phase cultures of Tetrahymena to which deuterium oxide has been added fifteen minutes earlier, the individual organisms continue to bind thymidine until the stage of mitosis at which DNA synthesis is normally completed and then cease due to an inability of the Tetrahymena to complete mitosis and enter the following synthetic cycle. On the basis of this continued DNA

synthesis, an explanation is offered for the protection afforded bacteria on inadequate medium by heavy water. The observations of this research and others reviewed are consistent with the theory that deuterium oxide blocks mitosis by stabilizing the intermolecular hydrogen bonds of the mitotic apparatus and the peripheral plasmagel, and so increasing their rigidity. (Dissertation Abstr.)

Ecology

Refer also to abstract 9341.

8533 (NYO–3216-1) A MODEL OF COMPETITION BETWEEN GENETICALLY VARIABLE POPULATIONS. Final Report. Wangersky, Peter J. (Yale Univ., New Haven, Conn. Bingham Oceanographic Lab.). [nd]. Contract AT(30-1)-3216. 9p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

In the model proposed it is assumed that the pattern of growth of a population can be approximated by using the population parameters of birth rate, gestation period, and survivorship curve measured at some low population density, and modifying the rate of population growth so obtained by a density-dependent factor working by some unspecified mechanism involving a finite time lag. Although the model is strictly deterministic, it is possible to insert some degree of variability in outcome. Competition equations programmed for digital computation were basically of the Lotka-Volterra type. (P.C.H.)

8534 (ORNL-P-1820) USE OF TRACER TECHNIQUES FOR THE STUDY OF BIOGEOCHEMICAL CYCLES. Olson, Jerry S. (Oak Ridge National Lab., Tenn.). [1965]. Contract W-7405-eng-26. 42p. (CONF-650722-1). Dep. mn. CFSTI $2.00 cy, $0.50 mn.

From 1st International Symposium on Ecosystems, Copenhagen.

Several steps by which tracers can be used, in conjunction with other methods, for approaching the ultimate goal of more insight regarding the functioning of ecosystems are discussed. The methods described are useful in comparing the mobility of several elements or element groups of the periodic table. Differences are consistent with expectations drawn from herbaceous plants, but are displayed in a striking manner by trees. Studies on oak saplings and a whole plot (20 × 25 m) of tulip tree forest using ^{45}Ca, ^{85}Sr, ^{42}K, ^{134}Cs, and ^{137}Cs are described. (P.C.H.)

8535 (TID–22443) DETAILED CHARACTERIZATION OF SOIL AND VEGETATION ON SELECTED SITES TO SERVE AS BASIS FOR FUTURE EVALUATION OF EFFECT OF RADIOACTIVE CONTAMINATION. Technical Progress Report, March 1, 1965–November 25, 1965. Haghiri, F. (Ohio Agricultural Research and Development Center, Wooster). Nov. 24, 1965. Contract AT (11-1)-414. 155p. Dep. mn; CFSTI $5.00 cy, $1.00 mn.

Separate abstracts were prepared on five sections of this report. (C.H.)

For abstracts of individual sections see: 8536, 8537, and 8552–8554.

8536 (TID–22443, pp 55-82) DISTRIBUTION OF GAMMA EMITTING ISOTOPES IN SOILS AS INFLUENCED BY TREES. Franklin, R. E.; Gersper, P. L.; Holowaychuk, N.; Elfield, M. (Ohio Agricultural Research and Development Center, Wooster).

An analytical method was developed for measuring small amounts of gamma ray emitting isotopes in soil and plant samples. The method utilizes a computer program written in SCATRAN, compensates for instrument instability and differences in bulk density between sample and standards. The computer time required for an analysis is approximately 0.5 minutes/sample on an IBM 7094 including a plot of the solution. The present capacity of the program is 14 standards which may be expanded to 30 standards. Utilizing this method the distribution of fission products in forested areas was determined. Cesium-137 concentrations in the surface soil was about 4 times higher within 1 foot of the stem of a Fagus grandifolia than at distances greater than 5 feet away. This concentrating effect near the stem appeared to be correlated with smoothness of bark and stem flow. There was appreciable downward movement of the fission products in the soil near the stem. Near the stem as much as 15 percent of the Cs-137 in the 0 to 12 inch layer of soil reached a depth of 6 to 9 inches, while only 1 percent reached this depth at positions further from the stem. The lateral distribution of γ emitters in soil under canopy trees was measured for Fagus grandifolia, Acer saccharum, Liriadendron tulipifera, Quercus coccinea, Carya glabra, and Quercus alba. (C.H.)

8537 (TID–22443, pp 83-99) MICROMORPHOLOGY AND MINERALOGY OF CANFIELD SILT LOAM. Holowaychuk, N.; Miller, F. P. (Ohio Agricultural Research and Development Center, Wooster).

An investigation was conducted into the micromorphology of the soil of the plot area, Canfield silt loam, by means of thin section techniques. Appreciable differences were observed between the ped surfaces of the fragipan horizon and their interiors in chemical and physical properties and to some extent in clay mineralogy. Since roots are concentrated on the ped surfaces the properties of the letter may be more pertinent to plants than those of the ped interiors. (auth)

8538 BEHAVIOR OF FISSION PRODUCTS IN SOIL. Beninson, D.; Migliori, A.; Mugliaroli, H.; Vander Elst, E. (Comision Nacional de Energia Atomica, Buenos Aires). pp 161-71 of Primera Conferencia Interamericana de Radioquimica. Washington, D. C., Union Panamericana, 1965.

The behavior of fission products in the soil of Ezeiza, Buenos Aires province, and the uptake of these radioisotopes by the vegetation of the area were investigated. Column experiments were made to determine the retention of the nuclide as a function of the depth, the vertical profile, and removal of retained activity by various solutions. Equilibrium suspension techniques were used to determine the influence of carrier concentration, the influence of various anions present, and the influence of various chemicals added to the soil. The uptake of fission products from the soil was measured in a series of greenhouse experiments. The data obtained on the retention of radionuclides in the soil are shown graphically. Removal in the liquid stage was very efficient for Sr, Cs, Ba, and Ce. The profiles of the various isotopes were determined. Removal of the activities by rain water was generally poor. Studies on fission-product uptake showed that Cs and Ru are poorly taken up and only a small fraction is found in the aerial parts of the vegetation. Radiostrontium was readily taken up and was more or less uniformly distributed in the plant. (J.S.R.)

Metabolism, Tissue Distribution, and Toxicology

Refer also to abstracts 8908 and 9266.

8539 (CONF–727, pp 32-8) EFFECTIVE HALF-LIFE OF POLONIUM. Sheehan, W. E. (Mound Lab., Miamisburg, Ohio).

Data on the elimination of polonium are presented for two cases of exposure, one by puncture with a contaminated wire and one by inhalation of polonium. The effective half-life of polonium in the inhalation case was 33 days, but the biological half-life of the puncture case was 24 days. (auth)

8540 (CONF-727, pp 47-64) THE PHYSICAL PARAMETERS OF PARTICULATES WHICH EFFECT RESPIRATORY TRACT DEPOSITION. Thomas, Robert G. (Rochester Univ., N. Y.).

Gross anatomy of the respiratory tract is reviewed with emphasis on the parameters that affect particulate deposition, particularly particle size and numbers and velocities that occur in air streams. The methods by which deposition

takes place are described, namely: impaction, interception, sedimentation, and Brownian movement. Methods for predicting deposition of uniform particulates and heterogeneous aerosols in the respiratory tract are discussed, and the effects of aerosol hygroscopicity on deposition are considered. (H.G.D.)

8541 (CONF-727, pp 65-75) WHOLE BODY DEPOSITION OF PARTICLES AS A FUNCTION OF VARIOUS PHYSICAL AND CHEMICAL PARAMETERS. Lie, Randi (Rochester Univ., N. Y.).

Experimental efforts on behavior of particulates in inspired air are reviewed. Parameters affecting particle deposition that are discussed include: size, density, and hygroscopicity. (H.G.D.)

8542 (CONF-727, pp 85-101) THE INTERPRETATION OF ANALYTICAL RESULTS FOR RADIONUCLIDES IN URINE. Jackson, S.; Dolphin, G. W. (Authority Health and Safety Branch, United Kingdom Atomic Energy Authority, Harwell (England)).

A brief summary is presented of the human data available on metabolism and excretion of Cs, P, Pu, Po, Sr, S, U, and tritium. Following a recognized accidental intake of a radionuclide, it is desirable to analyze a carefully planned series of urine samples, to provide a measure of the excretion rate of the individual and to minimize the uncertainty associated with single, isolated results. For assessment of routine urine analysis results from a group of personnel, the excretion data can be used to calculate the urinary concentration related to a chosen level of body content at which further investigation is required. Routine results should be carefully recorded for use in periodical reviews of their long-term significance. (auth)

8543 (CONF-727, pp 152-4) RECOVERY OF ^{241}Am IN THE PRESENCE OF DTPA. Low-Beer, Anne de G.; Parker, Howard G. (Lawrence Radiation Lab., Univ. of California, Berkeley).

An alkaline phosphate precipitation method for recovery ^{241}Am in the presence of DTPA was compared with wet-ashing recovery of ^{241}Am from the urine of rats. Recovery of ^{241}Am in the alkaline phosphate precipitates of rats that had not received DTPA was as good or slightly better than by the wet ashing method. In the animals that had received DTPA, recovery in the precipitate ranged from 39% on the first day to 7.7% on the sixth day showing a constantly increasing supernatant-precipitate ratio, which probably reflects an increasing chelate/method ratio in the urine excreted. It is concluded that at pH 8 ^{241}Am is strongly chelated, and accordingly the alkaline phosphate precipitation method is not suitable for the quantitation of urinary alpha activity in patients treated with DTPA. (H.G.D.)

8544 (COO-119-233) RESEARCH IN RADIOBIOLOGY. Semiannual Report of Work in Progress in the Internal Irradiation Program. Dougherty, Thomas F. (Utah Univ., Salt Lake City. Radiobiology Div.). Sept. 30, 1965. Contract AT(11-1)-119. 110p. Dep. mn; CFSTI $4.00 cy, $0.75 mn.

Separate abstracts were prepared on eight sections of this report. (C.H.)

For abstracts of individual sections see: 8507, 8545–8548, 8626, 8627, and 8742.

8545 (COO-119-233, pp 81-7) SOFT TISSUE RETENTION OF ^{90}Sr IN THE BEAGLE. Atherton, David R.; Stover, Betsy J. (Utah Univ., Salt Lake City. Radiobiology Div.).

The concentrations of ^{90}Sr found in the liver, kidneys, and spleen of beagles, measured at various times following injection, decrease with increasing time and, after a year or so, appear to decrease at the same rate as does whole body retention. These results are compared with similar measurements made on soft tissues from beagles injected with ^{226}Ra and with the calcium concentrations measured in the soft tissues of humans. (auth)

8546 (COO-119-233, pp 94-6) PREPARATION OF ^{90}Sr STANDARD IN PLASTIC BLOCK FOR DENSITOMETRIC EVALUATION OF RADIOAUTOGRAMS. Atherton, D. R.; Jee, W. S. S. (Utah Univ., Salt Lake City. Radiobiology Div.).

A bioplastic block with uniformly distributed ^{90}Sr was prepared for use as a standard for the evaluation of autoradiograms produced by exposure of film to tissue containing ^{90}Sr. The procedure and materials are reported. (C.H.)

8547 (COO-119-233, pp 101-5) USE OF THE CHINCHILLA IN THE STUDY OF BONE SEEKING RADIONUCLIDES. Taylor, G. N.; Brewster, L.; Mays, C. W.; Orme, S. (Utah Univ., Salt Lake City. Radiobiology Div.).

A brief evaluation of the suitability of the chinchilla as an experimental animal for toxicity studies dealing with several bone-seeking radionuclides is being made. This species has a maximum life span of 20 to 30 years, an epiphyseal closure time of 800 to 1000 days, and a skeletal to body weight ratio of approximately .07. The injected LD_{50-30} dose for ^{226}Ra, given in isotonic saline via a single subcutaneous injection is about 800 μC ^{226}Ra/kg. (auth)

8548 (COO-119-233, pp 106-9) RADIUM RETENTION IN CHINCHILLAS. Mays, Charles W.; Lloyd, Ray D.; Taylor, Glenn N.; Stair, Richard; Brewster, Lynn; Atherton, David R. (Utah Univ., Salt Lake City. Radiobiology Div.).

Preliminary results suggest that the early retention of radium in the chinchilla is similar to that in man. This similarity, combined with the chinchilla's long life span and small space requirements may make it an excellent animal for internal emitter RBE studies. Preliminary results are included from a study of the metabolism of injected ^{226}Ra in chinchillas. (auth)

8549 (HW-SA-3603) APPLICATION OF MINIATURE GOATS IN RUMINANT RESEARCH. Ragan, H. A.; Horstman, V. G.; McClellan, R. O.; Bustad, L. K. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). Dec. 10, 1964. Contract AT(45-1)-1350. 17p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

The African miniature goat, because of its small size (mature weight about 24 kg) and tractable disposition, was investigated for use as a representative ruminant in metabolic studies. Certain anatomical and physiological characteristics of these goats were determined and compared with those described for larger ruminants. In addition, these miniature goats were utilized in a preliminary study with radioiodine to determine the efficacy of their use in lactation studies utilizing radionuclides. Adult females received 0.15 μC ^{131}I daily prior to parturition and until their offspring were 3½ months of age. The thyroid, blood, and milk ^{131}I concentrations were determined. The results were compared with those obtained in previous studies with dairy cattle and sheep. It was concluded that these animals may find increased usage in laboratory experimentation in certain aspects of ruminant research. (auth)

8550 (LF-28, pp 111-27) THE WHOLE BODY RETENTION OF INHALED ^{137}Cs IN BEAGLE DOGS. Boecker, Bruce B. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.).

The whole body retention of a tracer level of ^{137}Cs deposited during a single, short inhalation exposure was followed in two groups of dogs. During the first experiment (25 dogs), the diet was changed by adding raw ground beef plus a vitamin and mineral supplement to the commercial food being used. Retention results from 8 dogs that were followed for 4 to 8 months after this diet change were examined. The mean value for the biological half life, T_b, just prior to the diet change was 42 days. After the diet change, the values of T_b for 6 of the 8 dogs decreased such that the mean value became 36 days. At 100 days post-exposure, the mean value of long term T_b was 30 days but considerable variation among these dogs was observed. These variations cannot be attributed to age differences. (auth)

8551 (LF–28, pp 160-3) LONG TERM EFFECTS OF INTRAVENOUSLY INJECTED ^{131}I ON RAT THYROID AND PITUITARY GLANDS. Chiffelle, T. L.; Scott, J. K. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.).

Rats were given three intravenous doses of 15, 25, and 45 μC of ^{131}I in order to control the amount of isotope entering the body. The initial measured body burdens are discussed. Histologic evaluation of the thyroid and pituitary glands are to be performed. (P.C.H.)

8552 (TID–22443, pp 1-33) INVESTIGATION OF DISTRIBUTION AND DISPOSITION OF FISSION AND RELATED NON-RADIOACTIVE MATERIALS IN SOIL AND VEGETATION FOLLOWING APPLICATION. Haghiri, F. (Ohio Agricultural Research and Development Center, Wooster).

The availability of stable strontium and other elements to plant as influenced by the frequencies of freezing and thawing cycles was studied. Treatments consisted of 1, 5, 10, 15, and 20 freezing and thawing cycles. In general, treatments had no significant influence on the yield and the mineral composition of soybean tops. Stable soil strontium was extracted from three different soil types with 0.1N, 1.0N, and 6N HCl and .01N and 1N HNO_3. Irrespective of soil type, more strontium was extracted with 6N HCl than with other solutions. Soil, plant, runoff water, runoff sediment, and leachate samples from micro-runoff plots were analyzed for ^{90}Sr and calcium contents. The ^{90}Sr activity of the 4 to 8 in. soil samples from ^{90}Sr treated plots under different cropping systems ranged from 1.07 to 2.84 percent. Total ^{90}Sr removal for gravel mulch, permanent grass, continuous corn, and crop rotation plots was measured. (C.H.)

8553 (TID–22443, pp 34-54) INFLUENCE OF ORGANIC COMPOUNDS ON THE MOVEMENT OF STRONTIUM IN SOIL AND ON THE UPTAKE BY PLANTS. Himes, F. L.; Mangaroo, A. (Ohio Agricultural Research and Development Center, Wooster).

The influence of organic compounds on the movement of Sr in soil and on the uptake of Sr by plants was studied. Soils formed under neutral conditions had higher constants than those formed under very acid conditions. The stability constants increased when clay minerals were removed. The movement of ^{90}Sr in soil columns containing 4 soils with varying amounts of organic matter was measured. The ability of water-soluble soil components to mobilize Sr in the soil columns was compared with that of known chelates. (C.H.)

8554 (TID–22443, pp 100-11) SAMPLING AND ANALYSES OF TREE LEAVES AND SOILS FROM STRONTIUM TREATED PLOTS. Holowaychuk, N.; Gersper, P. L. (Ohio Agricultural Research and Development Center, Wooster).

Analyses of tree leaf samples from plots treated with stable Sr show that species having a high Ca content take up considerably more Sr than do the low Ca content species on acid soils. This difference between species is much less marked on soils having a high content of bases. The biggest increase in uptake of Sr occurs during the second year after application. There is further but less marked increase after the second year in case of the high Ca content species whereas there is little if any such additional increase in the other species. (C.H.)

8555 (TID–22448) ^{131}I METABOLISM IN THE HUMAN. Final Research Report. Reece, Richard J. (Colorado State Dept. of Public Health, Denver). [1965]. Contract AT(11-1)-778. 49p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

Ten subjects, equally divided as to sex, were administered milk with an average of 200 pC ^{131}I daily for forty days. They were examined tri-weekly for thyroid uptake until levels approached background. The average thyroid uptake was 19 percent with the female uptake being slightly higher than that of the males. This shows that the 30 percent uptake assumption of the FRC and ICRP is conservatively biased. The apparent effective half life of the ^{131}I in the thyroid approached the physical half life of 8 days. Uptake three days after start of dosage was 32 percent. It then leveled off and remained fairly constant for the remainder of the study. Data are tabulated. (auth)

8556 MODELS AND EQUATIONS FOR DETERMINING DOH EXCHANGE AND ENRICHMENT IN PLANTS. Kunze, R. J.; Kirkham, Don (Iowa Agricultural and Home Economics Experiment Station, Ames). Agron. J., 57: 279-82(May-June 1965).

Equations were derived and experimentally verified, for exchange processes between DOH and HOH, and for enrichment processes that can occur when DOH is used as a tracer in soil-plant-water experiments. To derive the equations, simple models were used in which water in a petri dish evaporating under several conditions took the place of plant leaf water. The equations should apply to TOH–HOH systems and possibly to other two-component systems. (TCO)

8557 AN IMPROVED TECHNIQUE FOR SUBSOIL PLACEMENT OF RADIOISOTOPES. Newman, James S.; Hacskaylo, Joseph; Bloodworth, Morris E. (Texas Agricultural Experiment Station, Lubbock). Agron. J., 57: 315(May-June 1965).

Subsoil placement of radioactive solutions in the field with various types of injector apparatus presents a contamination hazard from accidental spillage. As long as only a few placements are needed, solutions may be used in spite of this hazard, but when a large number of field placements are required, a method which allows maximum speed, safety, and control is needed. For example, 1296 field placements of a radioactive material were needed in a study designed to determine the pattern of root growth in cotton. To lessen the hazard from accidental spillage of radioactive solutions and to insure a localization of radioactivity, an agar portion cup method was devised in which the radioactive solution is placed in paper cups and solidified with agar. An agar solution was heated in an autoclave and sufficient radioactive stock solution (in the case described, containing ^{32}P) was added to attain the desired concentration. The solution was then poured into $\frac{3}{4}$-ounce paper portion cups which were secured in $1\frac{1}{4}$-in. holes in a $\frac{3}{4}$-in. thick plywood tray during the pouring process. The wooden trays held 105 cups. The radioactive stock and agar solution was poured from one container to another above nonabsorbent table tops covered with adsorbent disposable paper. Each tray was placed on a protected table surface before the radioactive agar was poured into cups. Trays with filled cups were placed on a nonabsorbent table surface and shielded with lead sheets until the agar had jelled. Loaded trays were subsequently moved directly from the lab to the field where the radioactive agar was transferred to each placement hole. One pint of water was poured into each hole, and the holes were filled with soil and tamped. (BBB)

8558 CIRCULATORY EFFECTS OF RES DEPRESSION IN THE DOG. Banaszak, Edward F.; Kampine, John P.; Brault, Barbara A.; Smith, James J. (Marquette Univ. School of Medicine, Milwaukee). Amer. J. Physiol., 209: 532-8(Sept. 1965).

Dose-response relations for the canine reticuloendothelial system (RES) were studied using colloidal carbon gel (CCG), and the effects of RES depression, as produced with several agents, namely, CCG, Thorotrast, and silicon dioxide, on arterial blood pressure, splanchnic blood flow, and blood leukocytes were investigated. The response of the dog to single and repeated doses of CCG is similar to that reported in other mammalian species. At doses less than 30 mg/kg the clearance rate is high and limited only by splanchnic blood flow. At dose levels above 30 mg/kg the phagocytic index (K) approaches a constant. Large doses of CCG (160 mg/kg) and colloidal SiO_2 (350 mg/kg) induced a phagocytic depression accompanied by a marked granulocytopenia as well as prompt and delayed hypotensive reactions. Colloidal thorium dioxide (4 and 8 ml/kg) did not depress the phagocytic capacity of the canine RES for CCG.

Because repeated testing itself saturated the RES, additional experiments were performed in which the effects of large single injections of colloid were assessed on the basis of K tests done only at 4 and 8 hr after the injection of the depressing agent. A decided phagocytic depression after CCG and SiO_2 was seen but no marked changes in the Thorotrast-injected animals were noted. Thorotrast particles examined with the electron microscope revealed a mean dia of 75 ± 3 Å for one lot and 87 ± 4 Å for another lot. These were less than half the diameters of the carbon (250-300 Å) and the silica (350-400 Å) particles. Aside from particle size and suspending medium, however, there are multiple factors which may affect phagocytic capability toward a particular agent at any one time. These are discussed. (BBB)

8559 VITAMIN D-STIMULATED RELEASE OF CALCIUM FROM MITOCHONDRIA. Engstrom, George W.; DeLuca, Hector F. (Univ. of Wisconsin, Madison). Biochemistry, 3: 203-9(Feb. 1964).

The binding of ^{28}Mg, ^{45}Ca, ^{65}Zn, ^{89}Sr, and ^{133}Ba by mitochondria, as influenced by vitamin D, was studied in vitro. Administration of vitamin D to rats stimulated the release of calcium, strontium, and barium ions which had been actively bound by isolated kidney mitochondria. The effect of vitamin D was greatest with calcium and much less with strontium and barium. The effect of vitamin D on calcium release is observed only in the presence of an oxidizable substrate and is accompanied by a simultaneous release of inorganic phosphate. In the absence of oxidizable substrate (succinate) calcium is released rapidly from mitochondria by a process which is not dependent upon vitamin D. Furthermore, inhibitors of respiration or uncouplers of phosphorylation also cause an immediate release of calcium independent of vitamin D. The stimulation of calcium release by vitamin D can be observed with mitochondria from kidney, liver, and intestine but not from heart or brain. This stimulation is also found with kidney mitochondria from rats fed diets varying widely in calcium and phosphorus content. Large quantities of calcium in the incubation medium inhibit or mask the effect of vitamin D, presumably because of its uncoupling and inhibitory action on respiration. It appears that the retention of calcium by mitochondria depends upon at least a portion of the oxidative phosphorylation machinery, mitochondrial integrity, and pH. The vitamin is known to improve the intestinal absorption of calcium, strontium, barium, and magnesium in that order. This correlates well with the mitochondrial system except in the case of magnesium, since magnesium ions are bound to only a small degree by mitochondria under the conditions used. (BBB)

8560 THE EFFECT OF VARIOUS CALCIUM SALTS IN THE DIET ON THE ^{90}Sr DEPOSIT IN RAT BONES. Malkina, R. M.; Puchkova, S. M. Gig. Sanit., No. 9, 41-5(Sept. 1965). (In Russian).

Experiments performed on rats demonstrated that calcium was not absorbed uniformly. The extent of calcium absorption depended on the anion content of salts when it entered the gastrointestinal tract. The calcium was best absorbed from chloride and phosphate salts in the ratio of 1:1. The calcium oxalate was absorbed to an insignificant extent and the main mass of calcium passed through. Thus the anion composition of calcium salts affected strontium-90 deposition in rats' skeleton. (tr-auth)

8561 STUDIES ON THE ELIMINATION OF RADIOACTIVE STRONTIUM. I. EFFECT OF THE ADMINISTRATION OF CHELATING AGENTS. Ogawa, Eiichi; Fukuda, Ryuzo; Suzuki, Shiro; Shibata, Katsuhiro (Gunma Univ., Maebashi, Japan). Gunma J. Med. Sci., 10: 109-16(June 1961).

Mice of the dd strain were injected subcutaneously with 1 μC of ^{90}Sr (as the nitrate), and its excretion was followed after treatment of the mice with Ca ethylenediaminetetraacetate (EDTA), Na diethylenetriaminepentaacetate (DTPA), Na citrate, CaNa citrate, MgNa citrate, PbNa citrate, and Na tricarballylate. Twenty-four hr after the last injection of the agents, i.e., 72 hr after ^{90}Sr injection, all the animals were sacrificed, and the radioactivity in tissues was determined. All samples were stored for at least 4 weeks in order to obtain equilibrium between ^{90}Sr and ^{90}Y before counting with a G-M counter. Ca EDTA, Na DTPA, Na tricarballylate, Na citrate, and NaPb citrate, in the doses used, did not cause a significant change in either the excretion or skeletal deposition of ^{90}Sr. When NaCa citrate was given in combination with Na citrate in ratio of 1:2 at a dose of 13 mM/kg (as citrate), the excretion of ^{90}Sr was significantly enhanced in association with a decrease in its skeletal deposition. However, when the ratio was 2:1, no significant effect could be seen on radionuclide excretion. Mixtures of NaMg citrate and Na citrate at ratios of both 2:1 and 1:2 also accelerated the excretion of ^{90}Sr and inhibited its skeletal deposition. Thus the excretion of radionuclide three days after its administration was increased to 58% compared with 44% in control mice. (BBB)

8562 STUDIES ON THE ELIMINATION OF RADIOACTIVE STRONTIUM. II. EFFECT OF THE ADMINISTRATION OF TETRACYCLINE. Ogawa, Eiichi; Fukuda, Ryuzo; Suzuki, Shiro; Shibata, Katsuhiro (Gunma Univ., Maebashi, Japan). Gunma J. Med. Sci., 10: 117-20(June 1961).

Male mice were injected with carrier-free ^{90}Sr nitrate. Immediately after this, tetracycline was given intramuscularly once daily for 3 days. Control mice were given only ^{90}Sr solution. Twenty-four hr after the last injection of the agents, i.e., 72 hr after ^{90}Sr injection, all the animals were sacrificed, and the radioactivity in excretions and in tissues was determined after storage for at least 4 weeks in order to obtain equilibrium between ^{90}Sr and ^{90}Y before counting. When 0.1 mg of tetracycline was injected intramuscularly once daily for 3 days, the excretion of ^{90}Sr tended to increase, but this change was not significant. The skeletal retention of ^{90}Sr, however, showed a significant decrease. With Achromycin (Lederle brand of tetracycline) given in the same doses, the excretion of the radionuclide was significantly increased. When 1.0 mg of tetracycline was injected intramuscularly once daily for 3 days, the total and urinary excretion of ^{90}Sr showed a significant increase and the skeletal retention of ^{90}Sr was decreased significantly. Tetracycline has been previously shown to form a complex with various metals and to chelate with Ca or Sr. The amount of $MgCl_2$ contained in Achromycin did not exert any effect on the elimination of ^{90}Sr. When crystalline tetracycline alone was used, ^{90}Sr was also effectively removed. This result is attributed to the chelating action of tetracycline. (TCO)

8563 STUDIES ON THE ELIMINATION OF RADIOACTIVE STRONTIUM. III. EFFECTS OF THE ADMINISTRATION OF VARIOUS SALTS. Ogawa, Eiichi; Suzuki, Shiro; Fukuda, Ryuzo (Gunma Univ., Maebashi, Japan). Gunma J. Med. Sci., 11: 205-13(Sept. 1962).

Male dd strain mice, weighing 20 to 25 g, were subcutaneously injected with 1 μC of ^{90}Sr, and the effects of various salts upon its excretion and retention were investigated. The excretion and retention of ^{90}Sr did not show any significant change after the administration of $MgCl_2$ in a daily dose of 2.5 mg, but by its administration in a daily dose of 5.0 mg, the excretion of ^{90}Sr was significantly increased. The excretion of ^{90}Sr was significantly increased by administration of $MgSO_4$ in all the doses employed (daily doses of 3, 6, and 8 mg), and the retention in bone decreased in proportion with increase in the dose. The change was significant when a daily dose of 8 mg was given. When 0.05 mg and 0.5 mg of $SrCl_2$ were given as carrier of ^{90}Sr, the excretion and the retention of ^{90}Sr did not show any significant change. The excretion of ^{90}Sr was significantly increased after administration of Na_2SO_4 in a daily dose of 6.4 mg. After administration of NH_4Cl in a daily dose of 1.8 mg, a significant increase was seen in urinary excretion, but not in the total excretion. After administration of $NaHCO_3$ in a daily dose of 3 mg, the excretion of ^{90}Sr tended to decrease and the retention in bone tended to increase. After administration of Na_2HCO_3 in a daily dose of 3 mg, the excretion of ^{90}Sr tended to decrease and the retention in

bone increased significantly. After the administration of $Na_2S_2O_3$ in a daily dose of 16 mg, the excretion of ^{90}Sr increased significantly, and its retention decreased significantly in bone. After the administration of $Na_2S_2O_3$ in a daily dose of 4 mg, no significant change was observed in excretion and retention in bone of ^{90}Sr, while after administration of $Na_2S_2O_3$ in a daily dose of 8 mg, significant change occurred in the retention in bone. When $Na_2S_2O_3$ in a daily dose of 4 mg was given in combination with 1.25 mM/kg/day of $MgCl_2$ or of $CaCl_2$, there was significant increase in ^{90}Sr excretion, and significant decrease in its retention in bone. (BBB)

8564 STUDIES ON THE ELIMINATION OF RADIOACTIVE STRONTIUM. IV. EFFECTS OF THE ADMINISTRATION OF VARIOUS COMPOUNDS. Ogawa, Eiichi; Suzuki, Shiro; Fujii, Shunichi; Honma, Tsuyoshi; Tsuzuki, Hiroshi (Gunma Univ., Maebashi, Japan). Gunma J. Med. Sci., 13: 214-20(Sept. 1964).

Male mice of ddN strain, weighing 20 to 27 g, were injected with carrier-free ^{85}Sr and ^{90}Sr nitrate. These were neutralized and diluted with 0.9% sodium chloride solution, and 1 μC/0.1 ml solution was subcutaneously given to each mouse. Immediately after the administration of ^{90}Sr, the treatments were made with various drugs and subsequent treatments were given once daily for 2 days. Seventy-two hr after Sr injection, all the animals were sacrificed, and the radioactivity of ^{85}Sr in excretions and femurs was determined with a scintillation counter. In the ^{90}Sr experiments all samples were stored at least for 4 weeks in order to obtain equilibrium between ^{90}Sr and ^{90}Y, and then the activity was measured. Of the chelating agents tested, NaSr citrate and MgK aspartate in combination with NH_4Cl displayed a ^{85}Sr-eliminating effect. ATP and tetracycline increased Sr excretion without diminishing its retention in bone. Of the salts tested, Na thiosulfate alone or in combination with $SrCl_2$ was effective in eliminating ^{85}Sr; $SrCl_2$, Ca gluconate, Na polyphosphate, and chondoroitin sulfuric acid exerted no effect on radiostrontium excretion. No diuretics tested were effective. Of the hormones, glucocorticoids had an Sr-eliminating effect. Thyrotropin was effective, and antithyroid drugs, conversely, seemed to have excretion-diminishing effects. Of the vitamins, cocarboxylase increased ^{85}Sr excretion, but did not decrease its retention in bone. Also, metabolic inhibitors were ineffective, and NaF increased bone deposition of ^{85}Sr. Among SH drugs and weak chelating or complexing agents, no effective drugs were found. (BBB)

8565 EFFECT OF DIETARY CALCIUM ON SECRETION OF STRONTIUM INTO MILK. Comar, C. L.; Wasserman, R. H.; Lengemann, F. W. (Cornell Univ., Ithaca, N. Y.). Health Phys., 12: 1-6(Jan. 1966).

Dairy cows were raised from 5 months to 2½ years of age on either a basal ration that supplied 54 g calcium/day or the same basal ration but supplemented with inorganic, ^{90}Sr-free calcium so as to supply 121 g/calcium/day. Animals in both groups consumed essentially the same amount of ^{90}Sr and produced the same amount of milk. The milk from animals on the basal ration contained 8.4 pc ^{90}Sr/l as compared to 4.4 in milk from animals on the supplemented ration. Therefore the ^{90}Sr secretion into milk was approximately inversely proportional to calcium intake as was predicted from earlier experiments. This relationship was confirmed by a double tracer study using ^{85}Sr and ^{47}Ca. The extent to which the same relationship would hold outside the range of calcium intakes and dietary conditions used in the present study is not known. About 50 percent of the ^{90}Sr and calcium in the milk originated from the diet and about 50 percent from the body of the cow. (auth)

8566 ^{237}Np TOXICITY IN THE RAT. I. HISTOPATHOLOGIC AND CHEMICAL OBSERVATIONS IN LIVER AND KIDNEY. Mahlum, D. D.; Clarke, W. J. (Battelle-Northwest, Richland, Wash.). Health Phys., 12: 7-13 (Jan. 1966). (HW-SA-3886).

Neptunium (^{237}Np) administered intravenously as a citrate complex was acutely lethal to female rats at dose levels above 6 mg/kg, while males tolerated as much as 24 mg/kg. Hepatic and renal damage was sustained in all rats at dosages equal to or greater than 6 mg/kg. Hepatic damage consisted of morphological changes (cloudy swelling, fatty degeneration and lobular necrosis) and biochemical changes (fat accumulation, elevated Ca^{2+} and reduced K^+ concentrations). Renal tubular damage was similar to that observed in uranium poisoning. Both hepatic and renal damage appeared earlier and were more severe in females leading to their higher sensitivity and greater mortality. While the acute chemical toxicity of ^{237}Np was demonstrated, preliminary calculations indicate that the radiological hazard is more important for extended exposure, and no change is warranted in the current values for maximum permissible body burden or critical organ burden. (auth)

8567 DOSE DELIVERED TO THE THYROID AFTER INHALATION OF FISSION PRODUCTS. FISSION OF ^{239}Pu BY FAST NEUTRONS. Mechali, D.; Dousset, M.; Pardo, G.; Penotet, M. (Commissariat a l'Energie Atomique, Paris). Health Phys., 12: 15-27(Jan. 1966). (In French).

Among the various hazards arising from the inhalation of fresh fission products, irradiation of the thyroid is important. A criticality accident when all the fissions occurred within a very short lapse of time is discussed with emphasis on ^{239}Pu fast fission. The dose delivered to the thyroid by the several iodine isotopes after the inhalation of 1 mC of fission products was calculated as a function of the time elapsed between plutonium fission and inhalation. The presence of the parents of the iodine isotopes in the mixture of fission products was taken into account. (TCO)

8568 MANGANESE AND COPPER LEVELS IN HUMAN URINE. Kanabrocki, Eugene L.; Case, Lawrence F.; Fields, Theodore; Graham, Leonard; Miller, Edwin B.; Oester, Y. T.; Kaplan, E. J. Nucl. Med., 6: 780-91(Nov. 1965).

Four consecutive day urine collections were made by each of 16 apparently healthy male subjects ranging in age from five to 47 years. These urines were analyzed by a neutron activation technique for nondialyzable Mn and Cu. Average concentrations obtained were 0.8 ± 0.3 μg Mn per day, and 46.0 ± 9.7 μg Cu per day. Total Cu concentration, 50.4 ± 11.1 μg per day, was obtained by chemical analysis of these same urines. Similarity between the mean levels for total and non-dialyzable Cu suggest that the urine excreted Cu in normal subjects is present in a bound form. Forty-five daily urines were also obtained from 14 hospitalized adult male subjects and were analyzed for non-dialyzable levels of Mn and Cu. Manganese appears to be elevated in patients with myocardial infarction, cirrhosis of the liver, obesity (starvation diet), and schizophrenia. Copper appears to be elevated in patients with myocardial infarction and in Wilson's disease. (auth)

8569 RETENTION OF RADIOCOBALT BY HAIR, BONE AND VASCULAR TISSUE. Strain, William H. (Univ. of Rochester, N. Y.); Berliner, William P.; Tangeman, F. Thomas; Lankau, Charles A. Jr.; Pories, Walter J. J. Nucl. Med., 6: 831-7(Nov. 1966).

Cobalt-58 retention studies were conducted over a 20-day period in young and old rats of both sexes following injection of $^{58}CoCl_2$ in HCl solution. The data show that the uptake of the radioisotope was relatively high in aorta, kidney, and liver; relatively low in blood, femur, and hair; and age-dependent only in aortic tissue. These differences in retention of radiocobalt have been interpreted as being related to the distribution and elemental composition of the structural proteins. The results suggest that elastin retains more cobalt-58 than collagen or keratin. In agreement with this, the stable Co content has been found to be measurable only in elastin. The effects of age are shown by the enhanced uptake of cobalt-58 by aortic tissue of old rats. This finding correlates with previous evidence indicating an increased metal content and a change in amino acid composition of aortic tissue with increased age. (auth)

8570 DETERMINATION OF TRITIUM IN HUMAN URINE. Man, Sik Kang; Hack, Pil Chung. Kisul Yon'guso Pogo, 3: 66-8(1964). (In Korean).

The content of tritium in human urine before and after the Chinese nuclear explosion was estimated by liquid scintillation counting. The quenching effect of human urine was found to be negligible by treating it with activated charcoal so that the decolorized sample was employed for tritium determination without further treatment. The radioactivity of tritium was measured at −18°C ± 1 after 0.6 ml of decolorized sample was added to 7.6 ml of absolute alcohol and 11.8 ml of liquid scintillator. The scintillator was prepared by dissolving 4 g of PPO and 0.1 g of POPOP in 1 liter of toulene. Although as low as 0.7 μC/l of tritium can be estimated by this method, no activities due to tritium were detected. (auth)

8571 ELIMINATION VARIATIONS OF RADIOMERCURY IN RATS IN RELATIONSHIP TO THE DIFFERENT ADMINISTRATION TECHNIQUES OF DIMERCAPTOPROPANOL. Martinenghi, C.; Riccardi, A. (Univ., Milan). Minerva Nucl., 9: 149-52(May-June 1965). (In Italian).

The effectiveness of administering BAL to accelerate the elimination of ^{203}Hg in rats injected in a single dose at the point of maximum renal concentration of the tracer was shown in previous research. In the present investigation it was shown how effectiveness varies when single dose administration to rats is carried out at different time intervals from the moment of injecting the mercury, and on a parallel with this, what the effect is of repeated doses carried out in successive stages. It was observed that BAL action drops in intensity when the time interval is increased, although it remains fairly high even 48 hours after the introduction of the mercury. Repetition of the dose on each occasion causes a further drop in renal concentration of the tracer, although to a smaller extent compared with the effect of the first administration. (tr-auth)

8572 ^{210}Po IN MAN. Hill, C. R. (Inst. of Cancer Research, Belmont, Eng.). Nature, 208: 423-8(Oct. 30, 1965).

An attempt is made to define the part played by polonium-210 in contributing to the biological effective radiation dose received by man in a variety of environments. Gross concentrations of the nuclide that are found in human tissues together with some of their variations with environmental conditions are reported. The origin of the material and some information relating to its physiological and biochemical behavior which suggests that its distribution within a tissue may be rather nonuniform are discussed. On the basis of the data available, it is concluded that polonium-210 would evidently constitute a major fraction of the background dose to man, the total of which is generally considered to be of the order of 100 mrem/year. (J.F.P.)

8573 FUNCTIONAL SIMILARITIES BETWEEN THE CYTOPLASMIC ORGANELLES OF MELANOCYTES AND THE MITOCHONDRIA OF HEPATOCYTES. Van Woert, Melvin H.; Nicholson, Alexander R.; Cotzias, George C. (Brookhaven National Lab., Upton, New York). Nature, 208: 810, 811(Nov. 20, 1965). (BNL-9351).

The function of melanin-containing organelles found in the cytoplasm of melanocytes in Amphiuma liver was investigated. Comparisons were made between the melanin-containing organelles and mitochondria. Metal transport into isolated organelles was measured by assaying their uptake of carrier-free $^{54}MnCl_2$. Melanin granules within the organelles were also assayed to determine whether Mn crosses the membranes of the granules or whether it is transported only across the membranes of melanocytes and organelles. It was shown that melanin-containing organelles concentrate Mn in a manner similar to mammalian mitochondria. Activities of succinic oxidase and monoamine oxidase were determined for the melanin-containing organelles and mitochondria. (H.G.D.)

8574 DISTRIBUTION AND EFFECTIVE HALF-LIFE OF ^{58}Co IN HABROBRACON. Grosch, Daniel S. (Univ. of North Carolina, Raleigh). Nature, 208: 906-7(Nov. 27, 1965).

Distribution and effective half-life of ^{58}Co in Habrobracon were determined in wasps fed a single meal from a mixture containing 100 μc of carrier-free $^{58}CoSO_4$ per ml of saturated sugar water. In all sub-samples the effective half-life was attained by the third day following feeding. The abdomen retained most of the radioisotope, with the radioactivity level of the gut and its contents paralleling. Neither ovaries nor eggs were appreciably radioactive. (H.G.D.)

8575 EFFECTS OF IONIC PHOSPHATE INJECTIONS ON THE COLLOIDAL CHROMIC RADIOPHOSPHATE (^{32}P) DEPOSITED IN THE BONE. Anghileri, Leopoldo Jose (Comision Nacional de Energia Atomica, Buenos Aires). Naturwissenschaften, 52: 516(1965).

The feasibility of removing ^{32}P deposited in the bone by ionic phosphate injection was studied. White mice were injected intravenously with colloidal chromic phosphate. One group of animals received one intraperitoneal injection of isotonic phosphate buffer; a second group received two injections; and a third group received three injections. The animals were sacrificed 7 days after the radiophosphate injection and the distribution of the radioactivity was determined. The results show that the injected soluble phosphate has no effects on the bone-deposited colloid and only a slight effect on the whole-body radioactivity balance. (J.S.R.)

8576 METABOLISM OF RADIONUCLIDES IN FISH. I. STRONTIUM-CALCIUM DISCRIMINATION IN GILL ABSORPTION. Ichikawa, Ryushi; Oguri, Mikio (National Inst. of Radiological Sciences, Chiba, Japan). Nippon Siusan Gakkaishi, 27: 351-6(Apr. 1961).

Gill-perfusion experiments were conducted using the fresh-water or sea-water adapted eel Anguilla japonica. Discrimination against strontium in favor of calcium was observed in the gill absorption of these mineral ions, using ^{89}Sr and ^{45}Ca as tracers. (TCO)

8577 THE EFFECT OF RADON-CONTAINING WATER IN SWIERADOW-SPA ON THE DAILY EXCRETION OF ADRENAL STEROIDS. Halawa, Bogumil; Malinowski, Miron (School of Medicine, Wroclaw). Pol. Tyg. Lek., 19: 817-19(1964). (In Polish).

Attempts were made to detect effects of ingestion of Rn on adrenocortical function in patients drinking mineral water containing high levels of Rn for treatment of rheumatic diseases. The water was obtained at the spa in Swieradow, in lower Silesia, and was drunk by six control subjects and 38 with osteoarthritis, ankylosing spondylitis, and other chronic rheumatic diseases. Daily urinary excretion of 17-ketogenic and neutral 17-keto steroids was determined before, during, and after ingestion of the Rn-rich water. In the control subjects, 17-ketogenic steroid excretion levels fell slightly during therapy and still further after termination of therapy (from about 7.5 initially to 5.5 mg/24 hr). However, in the rheumatic patients, it rose markedly from about 7.0 mg/24 hr before treatment to 11.5 during and to 13.5 after treatment with Rn-containing water. The maximum rise occurred about one month after termination of treatment. Neutral 17-keto steroids showed no changes during treatment. It is suggested that Rn ingestion may cause stimulation of adrenocortical function and that this may play a part in the ability of radioactive spa waters to ameliorate rheumatic conditions. (BBB)

8578 THE GASTROINTESTINAL CLEARANCE OF ^{85}Sr AND ^{45}Ca IN MAN. Samachson, Joseph (Veterans Administration Hospital, Hines, Ill.). Radiat. Res., 27: 64-74(Jan. 1966).

Methods are given for calculating gastrointestinal clearances of ^{85}Sr and ^{45}Ca after intravenous doses of the radioisotopes. It is shown that the ratio of the gastrointestinal clearance of ^{85}Sr to that of ^{45}Ca may be calculated from stool values alone, without knowledge of the individual clearances. A method is also given for the calculation of true or corrected gastrointestinal excretion; that is, that which is secreted into the gastrointestinal tract and not reabsorbed. The true stool excretion pattern resembles that of urinary excretion. An increase in dietary calcium

raised ^{45}Ca gastrointestinal clearance more than it raised that of ^{85}Sr. The administration of hormones had variable effects on gastrointestinal clearances. An estrogenic hormone, Mytatrienediol, and a progestational hormone, Norlutin, in some cases decreased clearances and in others produced no change. (auth)

8579 INVESTIGATIONS ON THE MICRODISTRIBUTION OF INHALED RADIOPROMETHIUM (^{147}Pm). Hoelzer, Franz; Gensicke, Friedrich (Deutsche Akademie der Wissenschaften, Berlin). Strahlentherapie, 128: 396-405(Nov. 1965). (In German).

The distribution of ^{147}Pm in a few organs in white mice was determined radioautographically up to 120 days after inhalation of ^{147}Pm-chloride liquid aerosols. Initially, the highest absorption rate was observed at the epithelium of air conducting channels of the lungs. During the course of the experiment the activity decreased and was concentrated mainly in phagocytes, epithelial and alveolar cells, and in the interstitium. Radiopromethium was distributed homogeneously in the liver; in the femur it was found mainly in the osteoblastic tissue of the perichondrium and on the surfaces of the primary spongiosa. (auth)

8580 MEASUREMENT OF ^{59}Fe AND ^{55}Fe IN THE COMPOSITE SAMPLE. Nakajima, Akira; Yamamoto, Takaya; Sekiguchi, Eisuke; So, Seirin; Yoshitoshi, Yawara (Tokyo Teishin Hospital). Tohoku J. Exp. Med., 85: 21-32(Feb. 25, 1965).

For the study of Fe metabolism, the double-isotope method is used to follow absorption of Fe from the gut and its transport throughout the body. The best Fe isotopes for this type of study are ^{59}Fe and ^{55}Fe because of their convenient half lives. To measure the activities of ^{59}Fe and ^{55}Fe in a composite sample, a convenient differential counting method is presented. By calculating the photopeak area of the 1.10- and 1.29-Mev γ rays from ^{59}Fe, the minimum countable amount of 3.0×10^{-4} was obtained without any interference from other activities. The photopeak was measured by a NaI(Tl) crystal scintillation counter and a 256-channel pulse height analyzer. To measure ^{55}Fe activity, two methods were explored. In the first method, using a G-M counter, activities of the isotopes were measured using the 5.8-kev x rays from ^{55}Fe and β and γ rays from ^{59}Fe. Subtracting the contribution of ^{59}Fe estimated by a suitable correction rate of β and γ rays from ^{59}Fe, the amount of ^{55}Fe was deduced. As the counting efficiency of the 5.8-kev x ray is very low, the minimum detectable amount of ^{55}Fe was about 5×10^{-2}. Instead of Geiger-Mueller counter, a 1-mm thick NaI(Tl) crystal scintillation counter and a 256-channel pulse height analyzer were used in the second method. By subtracting the background and the interference of higher energies, the amount of ^{55}Fe was deduced from the photopeak area of this spectrum. The minimum detectable amount of ^{55}Fe in the second method was found to be less than 1/10 of the minimum detectable amount in the first method. (BBB)

8581 IODINE-CONCENTRATING CELLS IN THE ENDOSTYLE OF AMMOCOETES. Egeberg, Joern (Univ. of Copenhagen). Z. Zellforsch. Mikroskop. Anat., 68: 102-15(1965).

Certain epithelial cells in the endostyle of the ammocoete larva retain radioiodine following its administration. This glandular organ is found in primitive vertebrates such as protochordates, and in the larval state of cyclostomes prior to metamorphosis, and is classified as an exocrine gland homologous to the thyroid gland. Of the five cell types in the epithelium, autoradiographic examination has consistently shown that only the cell types 2c, 3, and 4, as well as a varying number of cells of type 5, concentrate ^{131}I. The ultrastructure of these cells is described and attempts made to identify the cell elements responsible for the organification of the radioiodine in larvae of Petromyzon planeri. Of the iodine-concentrating cells in the endostyle, the visceral cells (types 2c, 3, and 4) were provided with cilia and contained granules with a characteristic content of concentric lamellae. Type 3 was particularly rich in ergastoplasm. The parietal cells (type 5) were short with a polymorphous content indicating a resorptive rather than a synthetic function. Based on the ultrastructure of the cells it was not possible to decide which group forms the follicular epithelium in the petromyzone after metamorphosis, but it is most likely type 3 with its abundant protein-synthesizing apparatus. Presumably, type 5 cells have phagocytosed their iodine content from the endostyle lumen, and this assumption does not seem to be invalidated by the present examinations. Type 5 cells resemble reticuloendothelial cells and other macrophages. The fact that the absorption of iodine in type 5 cells is so variable indicates that constant synthesis of thyronines does not take place here. (BBB)

8582 UPTAKE, RETENTION, AND LOSS OF ^{65}Zn AND ^{137}Cs BY LITTORAL MARINE ALGAE [Thesis]. Gutknecht, John William. Chapel Hill, N. C., Univ. of North Carolina, 1964. 170p.

An apparent relation between photosynthesis and ^{65}Zn uptake was observed in unbuffered sea water. In buffered sea water, pH was found to have a greater effect on ^{65}Zn uptake than did light. Appreciable ^{65}Zn uptake occurred in the dark in all species. Therefore ^{65}Zn uptake is not directly related to photosynthesis. The high pH dependency of ^{65}Zn uptake suggests that adsorption-exchange is an important mechanism of ^{65}Zn movements. In Ulva and Porphyra observations indicated that at least part of the ^{65}Zn turnover was related to metabolism. ^{137}Cs uptake and loss appeared to be related to photosynthesis and/or rate of growth in several species. Concentration factors for ^{137}Cs were at least an order of magnitude lower than those observed for ^{65}Zn. It was estimated that nonmetabolic adsorption of ^{137}Cs by seaweeds was relatively low. The relation between Cs, Rb, and K movements was investigated in the red alga Gracilaria foliifera. Results suggest that ^{137}Cs uptake and loss in Gracilaria represent largely exchange-diffusion in which chemically similar ions may also participate. (A.G.W.)

8583 INVESTIGATIONS CONCERNING PROPOSED CATION UPTAKE MECHANISMS IN PLANTS [Thesis]. Onken, Arthur Blake. Stillwater, Okla., Oklahoma State Univ., 1964. 96p.

The proposed carrier and association-induction mechanisms for cation uptake were investigated. Short term absorption experiments were conducted. Intact seedlings of Sugar Drip forage sorghum, Sorghum vulgare Pers., nine to twelve days old were used as indicator plants. The ions used were cesium, sodium, potassium, and calcium. Experiments with cation uptake as a function of time were conducted in single salt solutions. Another series of experiments involved varying concentrations of single and double salt solutions. Selective cation uptake was studied using double salt solutions containing two tracer ions. Both temperature and ionic concentration of the absorbing solution were variables in one experiment. The effects of metabolic inhibitors were investigated. Energy available for cation uptake, as ATP, was determined. Aeration of the absorbing solution was found to have no advantage over non-aeration when 2.5 centimeters of the roots extended above the liquid surface. The cations used were found to satisfy the mathematical characterizations of both the carrier and association-induction mechanisms of cation uptake. Association or adsorption energy calculations indicated that the dissociation constants of both theories could be used as true thermodynamic constants. Activation energy and Q_{10} values were found to vary with absorption solution concentration. Sodium was found to be taken up selectively over cesium and calcium. Calcium was found to be taken up selectively over cesium. Selectivity coefficients for the various ions were found to increase with decreasing concentration of that ion in solution. It was not necessary to invoke the multiple carrier hypothesis to explain the selectivity observed. Metabolic energy was found to be necessary for cation uptake. The anaerobic energy for cation uptake, as ATP, was found to be inadequate to accomplish only one of four processes where it might have been used in a carrier system. (Dissertation Abstr.)

8584 THE INFLUENCE OF CONTACT TIME AND MINERAL TYPE ON THE EXTRACTABILITY AND AVAILABILITY TO PLANTS OF RADIOSTRONTIUM AND RADIOCALCIUM FROM SOILS [Thesis]. Johnson, Gordon Verle. Tucson, Ariz., Univ. of Arizona, 1965. 173p.

The influence of time of contact between soil and radiostrontium on labile radiostrontium was determined in availability studies with plants and by solution extraction and equilibration techniques. The effect of contaminant contact time on radiocalcium availability was compared to that of radiostrontium in similar availability studies. Five calcareous soils of widely varying properties and one acid soil were included in these investigations in order to evaluate the influence of soil characteristics on labile radiostrontium and radiocalcium. Since native caliche is usually present in calcareous soils, the sorption of radiostrontium and radiocalcium by suspended caliche particles was also studied. The results show that when soils are contaminated with radiostrontium, labile radiostrontium, as measured by availability to plants, chemical equilibration or extraction techniques, may decrease with increasing time of contact with certain calcareous soils. Considering the long half-life of ^{90}Sr such decreases in labile radiostrontium could be of significance in limiting the entrance of radiostrontium into the "food chain" from at least some soils. (A.G.W.)

8585 THE METABOLISM OF THE RADIOPROTECTIVE AGENT S-(2-AMINOETHYL)THIURONIUM BROMIDE HYDROBROMIDE (AET) IN MICE AND ITS IMPLICATIONS AS TO THE MECHANISM OF RADIATION PROTECTION [Thesis]. Kollmann, George John. Philadelphia, Temple Univ., 1965. 149p.

The distribution and metabolism of 2-mercaptoethylguanidine (MEG) and bis(2-guanidoethyl disulfide (GED) were studied in mice, using various doses of these radiation-protective agents, various routes of administration, and various intervals before sacrifice, in normal and tumor-bearing animals and in non-irradiated and irradiated mice. These studies were accomplished by using ^{35}S or ^{14}C-labelled materials. The following chemical forms were observed in all mice: bound MEG, GED, 2-guanidoethane sulfinic acid, taurocyamine, inorganic sulfate, S-acetyl-MEG, and free MEG. Two hours after GED administration i.p., when the animals were no longer protected, only the concentrations of bound MEG and free GED were decreased. All other forms were unchanged or increased. Oral administration gave a somewhat different distribution from intraperitoneal administration, and oral MEG was absorbed much more rapidly than oral GED. Tumor-bearing animals showed a different distribution from normal animals. Tumors were protected in mice given GED, and they were not protected in mice given MEG. The GED concentration in the tumors of GED mice was significantly higher than in the tumors of MEG mice. Irradiated animals showed a different distribution of GED from normal animals, but this appeared to be due to secondary effects and not an indication of mechanism of action. In general, only the concentrations of the bound MEG and free GED showed correlation with radiation protection. Binding was mainly by mixed disulfide bond with protein sulfur groups and by thioester bond with protein carboxyl groups. Both bound forms correlated with protection. It is postulated that bound MEG or free GED or both are involved in the mechanism of radiation protection. (Dissertation Abstr.)

8586 FACTORS INFLUENCING THE LEVELS OF ^{137}Cs SECRETED IN MILK [Thesis]. Stewart, Harold Franklin. New York, New York Univ., 1964. 47p.

The levels of fallout cesium-137 were determined in samples of alfalfa hay, pasture, silage, and grain mix fed to the Colorado State University herd from 1962 to 1964. It was seen that the change of cesium-137 activity in hay each year was dependent on the rate of fallout rather than that accumulated in the soil. The change in activity with cuttings during the same year showed the same general pattern each year. The highest activity occurred in the first cutting of hay with progressively lower levels in each subsequent cutting. The cesium-137 activities of grain were about three-fold lower than third cutting hay and ten to fifteen-fold lower than first cutting hay. Relationships between cesium-137 intake and secretion into milk were studied for individual cows and groups of cows on pasture and in dry lots. The cesium transfer coefficient, defined as the percentage of cesium-137 consumed that was secreted per liter of milk, was found to be independent of the level of production. The value of the transfer coefficient averaged .37 and .34 for the dry-lot and pasture herds respectively. The cesium transfer coefficient for cows on a high-grain, low-roughage ration was higher (averaging .65) than that for cows on a low-grain, high-roughage diet (averaging .39). This effect was attributed to the crude fiber content of the ration although it is possible that there are other explanations. Body balance studies of fallout cesium-137 on three lactating dairy cows indicated that the absorption from the gastrointestinal tract was lower than values reported for cows given soluble tracer cesium. (Dissertation Abstr.)

8587 RADIOCHEMICAL METHOD OF DETERMINATION OF CHLORIDE (^{36}Cl) ABSORPTION OF MYCELIUM OF ASPERGILLUS PHOENICIS (GROUP A. NIGER). Nussis, N.; Perez del Viso, R. (Univ. Nacional del Litoral, Santa Fe, Argentina). pp 33-8 of Primera Conferencia Interamericana de Radioquimica. Washington, D. C., Union Panamericana, 1965. (In Spanish).

The absorption of chlorine ions by a strain of Aspergillus phoenicis (group A. Niger) was investigated by radiochemical techniques when the chlorine ions were released by the Aspergillus phoenicis growing in a culture containing ammonium chloride as a nitrogen source. ^{36}Cl-labeled NH_4Cl was used as the tracer compound. An increase of the chloride concentration in the culture medium of the order of 2% was observed. The increase was caused by factors other than evaporation and respiration. This indicated that the mycelium cells partially retain the chloride ions released by assimilation of the nitrogen of the ammonium ion. The mycelium washed exhaustively retained approximately 0.4% of the chloride present in the initial medium. During the washing it was observed that part of the retained chloride diffused into the liquid slowly within a period of 44 min; this suggested its absorption on mycelium cells. A complete balance of the distribution of the chlorine confirmed this hypothesis. (J.S.R.)

Radiation Effects on Biochemicals

See also CHEMISTRY — Radiation Chemistry

8588 (BNL–9537) BIOLOGICAL DAMAGE AND FREE RADICALS IN IRRADIATED SEEDS. Conger, Alan D. (Florida Univ., Gainesville. Brookhaven National Lab., Upton, N. Y.). [1965]. Contracts AT(40-1)-2579; AT-30-2-GEN-16. 25p. (CONF-650561–1). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

From Symposium on Electron Spin Resonance in Biology, Gatlinburg, Tenn.

The correlation between the number and rate of decay of free radicals and the amount and rate of development of radiation damage in seeds irradiated and stored dry before being placed in water to initiate growth is discussed. Electron spin resonance was used to detect free radicals induced by exposure of seeds to low and high doses of γ, x, and fission neutrons. The effects of postradiation storage time, temperatures ranging from –196°C to 100°C, water content of the seeds, and atmosphere consisting of oxygen, nitric oxide, or H_2S before, during, or after irradiation on free radical production and decay rate were measured and compared with biological damage as revealed by the development of seeds and embryos. The amount of damage was found to be inversely proportional to the number and decay of free radicals. (C.H.)

8589 (LF–28, pp 209-29) EFFECTS ON BLOOD CHEMICAL CONSTITUENTS OF THE INHALATION OF

^{131}I OR ^{90}Sr BY RATS AND ^{90}Sr BY DOGS. Van Stewart, E.; Longwell, B. B. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.).

Albino rats and beagle dogs were exposed by inhalation to aerosolized radioisotope preparations, and blood was analyzed for 26 constituents at intervals after the exposure. Rats received ^{131}I at two dose levels and ^{90}Sr at a single dose level. Dogs received ^{90}Sr at one dose level only. Ultramicro quantification of blood constituents showed no deviations from the values of the unexposed, control animals in the ^{131}I experiments with rats. However, male rats that received ^{90}Sr developed osteogenic neoplasms, some of which were located in the vertebrae causing cord compression syndrome. No deviations from normal were observed in the blood of dogs exposed to ^{90}Sr. Data are tabulated. (P.C.H.)

8590 AUTORADIOGRAPHIC AND RADIOCHEMICAL STUDIES ON THE INFLUENCE OF AN X-RAY WHOLE-BODY IRRADIATION ON THE SULFOMUCOPOLYSACCHARIDE METABOLISM OF THE RAT AORTA. Kunz, J.; Braselmann, H. (Univ., Berlin). Acta Biol. Med. Ger., 14: 570-5(1965). (In German).

The uptake of ^{35}S-sulfate in various segments of aorta was studied by autoradiography in normal and irradiated male adult rats. The animals were injected intraperitoneally with 0.5 mC of carrier-free $Na_2{}^{35}SO_4$ per 100 g body weight and sacrificed 24 hr later. Irradiated rats received 500 R doses of 200 kv x rays, and were injected with ^{35}S one to 26 days later. The photometric evaluation of autoradiographs of the unirradiated rat aorta following a ^{35}S-sulfate injection showed a more significantly increased incorporation of the isotope in the ascending thoracic aorta than in the descending thoracic aorta and abdominal aorta. Reversible disturbances in sulfomucopolysaccharide metabolism consisted of an initial increase with a subsequent inhibition of the synthesis and an accelerated degradation. Thus, ^{35}S-sulfate incorporation was 30% higher than normal one day postirradiation, 50% below normal at four days, and near the normal level 10 to 26 days after irradiation. Changes in sulfomucopolysaccharide metabolism paralleled the severity of the acute radiation syndrome. (TCO)

8591 ACQUIRED RESISTANCE IN MICE AND RATS AFTER EXPOSURE TO GAMMA-IRRADIATED CERCARIAE. Erickson, Duane G. (Walter Reed Army Inst. of Research, Washington, D. C.); Caldwell, William L. Amer. J. Trop. Med. Hyg., 14: 566-73(July 1965).

Attempts were made to induce resistance to Schistosoma mansoni in mice and rats by exposure to irradiated cercariae. No effect on penetration or maturation was evident when the cercariae were irradiated with 1000 R of γ radiation from ^{60}Co. Cercariae irradiated with 2500 to 3000 R developed into schistosomes in which egg production was greatly decreased as compared with normal worms. When irradiated with more than 4000 R, the worms did not survive 8 weeks in mice, but even irradiation with 10,000 R failed to affect cercarial penetration. Repeated exposures of mice to cercariae irradiated with 6000 to 8000 R produced greater resistance than did a single exposure to irradiated schistosomes. Resistance was manifest either as a reduction in the number of worms maturing from a subsequent exposure to nonirradiated cercariae or as prolonged survival after exposure to otherwise lethal numbers of nonirradiated cercariae, or both. Exposure of rats to irradiated cercariae enhanced their natural resistance as measured by reductions in worm burdens 4 and 9 weeks after exposure to a challenging infection. Four exposures of 5000 irradiated cercariae each produced greater resistance than did three exposures to 1000 irradiated cercariae. Infections with irradiated schistosomes induced greater resistance in rats than did infections with nonirradiated worms. One explanation for this may be the closer and more prolonged contact of irradiated worms with the liver tissue than is seen in normal infections. In the normal infection, as schistosomes mature in the liver venules, they migrate into the larger vessels. Another factor in the difference in immunity evoked by irradiated and normal worms is the debilitating effects of the normal infection on the host. (BBB)

8592 ELECTROPHORETIC PATTERN OF PLASMA PROTEINS, LIPOPROTEINS, AND GLYCOPROTEINS IN WOMEN WITH GENITAL NEOPLASMS AND ITS CHANGE IN THE COURSE OF RADIOTHERAPY. Fontana Donatelli, G. (Univ., Milan). Ann. Ostet. Ginecol., 84: 745-72 (Sept. 1962). (In Italian).

Paper electrophoretic studies of plasma protein fractions were performed in 24 patients with gynecologic cancer (mostly of the uterine cervix) submitted to pelvic irradiation with ^{60}Co. Daily doses of 150 to 200 R were given until total doses of 5000 to 6000 R were reached. Plasma protein patterns were followed throughout the irradiation period. In addition to protein fractions, lipoproteins were determined by staining the paper strips with Sudan black and glycoproteins by the periodic acid-Schiff reaction. As therapy proceeded there was a tendency for albumin to increase and for α_1-, α_2-, and β-globulins to decrease. The albumin/globulin ratio rose. All of these fractions were abnormal prior to therapy in these cancer patients compared with normal subjects. With increasing accumulated radiation doses, both α- and β-lipoproteins increased, while the slow β-lipoprotein fraction and the β/α ratio declined. Glycoprotein fractions tended in rise in the albumin and γ-globulin zones while decreasing in the α_1-, α_2-, and β-globulin zones. The glycoprotein albumin/globulin ratio increased. (BBB)

8593 EXPERIMENTAL ANIMAL STUDIES OF THE EFFECT OF HYPNOTICS AND SEDATIVES ON THE RADIOIODINE TEST. Bruns, W.; Haeusler, G.; Kutzim, H. (Universitaet, Cologne, Ger.). Arzneimittel-Forsch., 13: 796-8(Sept. 1963). (In German).

The effects of several hypnotics and sedatives, including methylphenobarbital, phenobarbital, glutethimide, thalidomide, and fluphenazine dihydrochloride, on ^{131}I uptake by the thyroid and on formation of PB ^{131}I were studied in 160- to 200-g rats. Thiamazole was used as a control substance for comparison of the values obtained. Compared to control groups that received no drugs, the animals that received methylphenobarbital, phenobarbital, and glutethimide showed large increases in thyroid uptake and formation of PB ^{131}I. When methylphenobarbital was administered for 2 weeks prior to the ^{131}I tests the uptake was increased by ~35%, but if this drug was administered for 4 weeks the uptake was increased by ~56%. Doubling the dose from 20 to 40 mg/kg had no effect. Thalidomide had no statistically significant effects on the storage of ^{131}I in thyroid, but reduced the PB ^{131}I values by ~60%. Fluphenazine reduced ^{131}I uptake by ~25%. Thiamazole treatment reduced uptake and incorporation of ^{131}I by more than 65%, compared to the control animals. Of the several hypnotics and sedatives studied, none appeared to be appropriate for sedation of patients prior to a ^{131}I thyroid uptake test. (BBB)

8594 ON THE BEHAVIOR OF DIFFERENT ENZYME ACTIVITIES IN YOUNG AND OLD BOVINE LENSES AFTER X IRRADIATION AND SUBSEQUENT STORAGE IN NUTRIENT SOLUTION. Korte, I.; Hockwin, Otto (Univ.-Augenklinik Bonn). Ber. Deut. Ophthalmol. Ges., 65: 309-11 (1964). (In German).

Bovine lenses, removed within 2 hr after death of the animals, were irradiated with 20 kR of x ray at a rate of 1800 R/min. The irradiated lenses were then incubated at 37°C for a 48 hr under sterile conditions and the activities of the enzymes aldolase, lactic dehydrogenase, glucose-6-phosphate dehydrogenase, triose isomerase, pyruvate kinase, hexokinase, and glycerokinase were measured and compared with those from unirradiated lenses. There were no essential differences between enzymatic activities of fresh and incubated lenses. In addition, there was no clear-cut indication that irradiation had any effect at all on the activities of the enzymes. In some instances enzymatic activity was increased in irradiated lenses, but these differences were no greater than the few instances of decreased activity observed after irradiation. None of the

differences observed was statistically significant. Apparently the enzyme molecules studied were not directly affected by the x irradiation used. (BBB)

8595 CESIUM CHLORIDE DENSITY-GRADIENT STUDIES OF NUCLEAR PROTEINS. STUDIES WITH CONTROL AND IRRADIATED NUCLEI. Lehnert, Shirley; Okada, S. (Univ. of Rochester, N. Y.). Biochim. Biophys. Acta, 109: 557-67(Nov. 29, 1965).

Nucleoprotein gels were fractionated on a CsCl density gradient. The major component separated was found in a peak of density 1.66 g/cm^3, consisting of nearly all the DNA and part of the histone originally present in the nucleus. The remainder of the histones was found in a layer floating on the surface of the CsCl. The residual or acid-insoluble protein was found in a peak of density 1.48 g/cm^3; possibly due to reaction with CsCl this fraction exhibited some unusual properties, notably an ultraviolet absorption maximum of 320 mμ. Nucleoprotein and purified DNA added separately to the gradient were located in the same peak after centrifugation. Homogenization of nucleoprotein before centrifugation apparently separated most of the DNA from the protein. Some conclusions about the arrangement of DNA and protein in the chromosome are drawn from these findings. Doses of x irradiation up to 10^6 rad given to rat-liver nuclei in vitro do not produce any major changes in the buoyant density of the main nucleoprotein component. Doses as low as 100 rad result in the appearance of a second peak on the density gradient of buoyant density 1.75 g/cm^3, containing DNA and material with an absorption maximum at 320 mμ. It seems likely that the material in this peak is a radiation-induced complex of DNA and the low-density 320 mμ-absorbing material observed in control nuclei. (auth)

8596 MODIFICATION OF RIBONUCLEASE STRUCTURE BY GAMMA IRRADIATION. Slobodian, E.; Newman, W.; Fleisher, M.; Rubenfeld, S. (New York Univ., New York). Biochim. Biophys. Acta, 111: 181-90(Nov. 15, 1965).

Ribonuclease A (polyribonucleotide 2-oligonucleotidotransferase), in aqueous solution, has been irradiated with γ rays, and 80 to 90% inactivated samples were selected for chemical studies. Titrations of freshly irradiated samples with p-hydroxymercuribenzoate indicated 2 SH groups per molecule of enzyme. Irradiated samples were also alkylated with [I-^{14}C]iodoacetic acid, and the alkylated proteins were purified, hydrolyzed, and analyzed for constituent amino acids; 2 residues of radioactive S-carboxymethylcysteine were found per molecule of enzyme. The results are evidence that rupture of disulfide bridges is one of the molecular changes caused by irradiation. Unlike the native enzyme, irradiated ribonuclease A is digested by trypsin; the amount of proteolysis obtained was about half of that observed in the tryptic digestion of fully reduced ribonuclease A. Complete amino acid analyses of several irradiated samples showed the consistent loss of only a few residues, namely, histidine, tyrosine, methionine, and lysine. (auth)

8597 ORIGIN OF THE TAURINE EXCRETED BY AN IRRADIATED RAT. Boquet, P. L.; Fromageot, P. Bull. Inform. Sci. Tech. (Paris), No. 93, 7-18(May 1965). (In French).

The taurine excreted in excess by a rat irradiated with doses close to 500 R comes from the loss of a stock of this product in tissues and not from an increase in its biosynthesis. In a normal organism, the taurine thus freed is rapidly added to the circulating taurine. Irradiation does not modify the capacity of the muscular tissue for concentrating taurine. The destruction of all high mitotic index cells by ionizing radiations frees an amount of taurine compatible with that observed. Current experiments examine the possibility of partial resorption of excess circulating taurine by combining it with cholic acid and its derivatives. (auth)

8598 THE DIFFERENTIAL SENSITIVITY OF GENETIC LABELERS TO ULTRAVIOLET RADIATION AND THE REACTIVATION MECHANISMS DURING THE TRANSFORMATION IN DIPLOCOCEUS PNEUMONIA. Louarn, Jean-Michel; Sicard, Armand Michel (Centre National de la Recherche Scientifique, Gif-sur-Yvette, France). Compt. Rend., 261: 852-5(July 19, 1965). (In French).

The caffeine inhibition of the reactivation to darkness does not modify the transforming power of DNA irradiated in vitro. This can be due to the fact that the DNA carrier of reactivatable lesions is not integrated. (tr-auth)

8599 DIFFERENTIAL ACTION OF PREVIOUSLY IRRADIATED OR UNIRRADIATED 3,4- OR 1,2-BENZOPYRENE ON THE EGG OF ASCIDIA. Bouchard, Jacques (Univ. Paris, Orsay, France). Compt. Rend. Soc. Biol., 159: 540-4(1965). (In French).

Eggs of Ascidia mamillata were treated at the 2-blastomere stage by acetone or nicotinic solutions containing either 3,4- or 1,2-benzopyrene; some of the benzopyrene was irradiated before use. The irradiation of these substances before their use, either by solar uv or in the laboratory, modified the hydrocarbon which, in the egg, becomes antagonistic. Irradiation accentuates the contrast between 3,4- and 1,2-benzopyrene, 3,4-benzopyrene playing a more antagonistic role. (tr-auth)

8600 GLUCOSE-6-PHOSPHATASE ACTIVITY IN THE KIDNEY OF THE MOUSE AND RAT DURING EXPERIMENTAL INTOXICATION WITH URANYL NITRATE. BIOCHEMICAL AND HISTOCHEMICAL STUDY. Bastide, P.; Bastide, J.; Malet, P.; Turchini, J. P.; Dastugue, G. Compt. Rend. Soc. Biol., 159: 689-92(1965). (In French).

The variations of the glucose-6-phosphatase that hydrolyzes the glucose-6-phosphate into glucose and phosphate were studied in rats and mice during experimental intoxication with uranyl nitrate. The animals were sacrificed 24, 48, 72, and 96 hr after injection of the nitrate. Histochemical and biochemical studies were made of the kidney. The results showed more than a 50% decrease of the glucose-6-phosphatase in both the rat and the mouse after uranyl nitrate poisoning. (J.S.R.)

8601 DEMONSTRATION OF A CYTOTOXIC AGENT IN GAMMA-IRRADIATED CARBOHYDRATE SOLUTIONS. Berry, R. J. (Churchill Hospital, Oxford); Hills, P. R.; Trillwood, W. Int. J. Radiat. Biol., 9: 559-72(1965).

Irradiated carbohydrate solutions were found to be toxic to mammalian cells in vitro. For 1 per cent solutions of dextrose or fructose added to the growth medium, the effect is maximal after a dose of ~10^5 rads. The toxic product, once formed, is heat-stable and persists after the heavy irradiation needed for sterilization for more than 6 months. Autoclaved dextrose and fructose solutions also show some cytotoxicity, but this is less pronounced in aged solutions. (auth)

8602 SENSITIVITY OF ARTEMIA EGGS TO γ-IRRADIATION. VII. RELATIONSHIP BETWEEN THE DEGREE OF BIOLOGICAL DAMAGE AND THE DECAY OF FREE RADICALS IN IRRADIATED EGGS. Iwasaki, Tamiko (National Inst. of Radiological Sciences, Chiba, Japan). Int. J. Radiat. Biol., 9: 573-80(1965).

Experiments pertaining to the relationship between radical amount measured by ESR and biological damage of dried Artemia eggs irradiated with γ-rays are described. The amount of free radicals increased with the increase of the dose of irradiation; however, the relation was not linear. At the same time, the hatchability rate of the eggs decreased with the exposure dose, producing a sigmoid curve. The amount of free radicals produced by irradiation in the intact eggs was similar to that in the denuded eggs. The radical decay was very rapid, immediately after irradiation, then retarded. However, hatchability decreased continuously with time after irradiation. The hatchability and radical-decay rate of the irradiated eggs stored at 25°C decreased much more rapidly than those at dry-ice temperature. From the results, it is concluded that decay of free radicals does not imply recovery from radiation damage but continues to the point of fixation of the damage. (auth)

8603 LIBERATION OF 5-HYDROXYTRYPTAMINE IN THE RAT BRAIN STEM AFTER X IRRADIATION. Palaic, Dj.; Supek, Z. (Inst. Ruder Boskovic, Zagreb). Int. J. Radiat. Biol., 9: 601-4(1965).

The radioinduced increase of total 5-OR indoles (R meaning H, aryl, or alkyl group) in the rat brain stem following whole-body 900 R dose of x rays was studied. Results showed a significant increase of total 5-OR indoles in the rat brain stem immediately, 24, and 48 hrs after irradiation. However, a significant decrease of basic 5-OR indoles was noted on the second day post-irradiation. It appeared that the 5-OR indole increase was connected with the enhanced liberation and biosynthesis of 5-hydroxytryptamine (5-HT) after irradiation. The decrease of 5-HT content 48 hrs after irradiation probably is not only due to the enhanced liberation of 5-HT, but also to the inhibitory effects of x rays on 5-HT biosynthesis. It was indicated that changes of 5-OR indole content in the rat brain after irradiation depend on the time-interval after irradiation and the site of irradiation. (H.G.D.)

8604 THE EFFECT OF MEGAVOLTAGE TOTAL BODY IRRADIATION ON EXPERIMENTAL BLADDER CALCULOGENESIS. Cockett, A. T. K.; Nakamura, R. M.; Fingerhut, A. G.; Kado, R. T. (Univ. of California, Los Angeles). Invest. Urol., 3: 33-5(July 1965).

An earlier preliminary report indicated that 300-rad x irradiation caused smaller than usual stones to form in the bladder of rats implanted with a magnesium disc. To test the validity of this finding by using a more powerful energy source for irradiation, three groups of male rats were subjected to increasing doses of whole-body irradiation (150, 300, and 450 rad) with a 6-Mev linear accelerator. A magnesium disc weighing 11 mg had been implanted nine days earlier into the urinary bladder with aseptic surgical techniques. The rats were sacrificed nine weeks following irradiation, and plasma was obtained for calcium and phosphorus determinations. Bladder calculi when present were dried and weighed, and the magnesium disc weights subtracted. The weight of the stones seen in the four groups were as follows: control rats, 72.1 mg; rats with discs (irradiated 150 rad), 84.7 mg; rats with discs (irradiated 300 rad), 53.4 mg; and rats with discs (irradiated 450 rad), 71.0 mg. The serum phosphorus levels were lower in the 300-rad irradiated group, whereas in the 150- and 450-rad irradiated groups the values were similar to those of the unirradiated group with discs. Total phosphorus values average 8.21 mg/100 ml in the control groups, and 7.22, 6.75, and 787 in the respective irradiated groups. The serum calcium levels did not show any significant differences in the various groups. The apparent specific protective effect of 300-rad, total-body irradiation, as opposed to no effect at 150 or 450 rad, was unexpected and difficult to explain. Four possible mechanisms of action of radiation are postulated, in terms of its effect on bone, the gastrointestinal tract, kidneys, and bladder. No one mechanism was favored but it is pointed out that the magnesium disc acts as an irritating focus for stone formation, and the local inflammatory response probably contributes to the formation of the stones; it is known that small doses of radiation interfere with the inflammatory process. (BBB)

8605 EFFECT OF LOCAL BETA IRRADIATION ON THE METABOLISM OF THE RABBIT CORNEA. Korecz, Karl; Szirmak, Evan (Peterfy Sandor Hospital, Budapest). Klin. Monatsbl. Augenheilk., 146: 204-10(Mar. 1965). (In German).

Anaerobic glycolysis and respiration were measured by the Warburg method in sections of cornea from rabbit eyes exposed to various doses of β radiation. The radiation was given with a 25.6-mC ^{90}Sr source with a 5-mm window giving a dose rate at 4 mm distance of 120 rep/min. The right eye of rabbits was exposed to fractions of 1000 rep given every second day for total doses up to 5000 rep. Six weeks after the last exposure, frozen sections (3 to 4) of the cornea were prepared and their metabolic activity measured. After a local dose of 1000 rep, the average O_2 uptake of cornea was diminished 3%. After 1500, 3000, and 5000 rep, it was 2, 13.6, and 45% lower than that of control tissue. The average CO_2 production of cornea exposed to 1000, 1500, 3000, and 5000 rep was 3, 0.4, 3, and 35% lower than that of unirradiated corneal tissue. No pathologic changes were grossly evident in irradiated cornea except at the highest dose, after which epithelial changes were noted. No hematologic changes were observed in the eye-irradiated rabbits. (BBB)

8606 ELECTRON SPIN RESONANCE IN X-IRRADIATED ORIENTED DEOXYRIBONUCLEIC ACID. Elliott, J. P.; Wyard, S. J. (Guy's Hospital Medical School, London). Nature, 208: 483-5(Oct. 30, 1965).

Some preliminary findings from ESR investigations made with an oriented sample of calf-thymus DNA are reported. The ESR spectra of dry calf thymus DNA fibers x-irradiated at room temperature is shown, with separate spectra for fibers parallel to the magnetic field and for those normal to the field. From these and other observations and theoretical considerations it is concluded that presumably the asymmetry of the perpendicular spectrum arises both from asymmetry in contributions from any one radical species due to simultaneous g-value and hyperfine anisotropy and the asymmetry arising from differences in the mean in-plane g values of the various species supposed to be present. (J.F.P.)

8607 QUANTUM ENERGY SPECIFICITY OF SIMPLE PHOTORECEPTOR UNITS. Dawson, William W. (Univ. of Florida, Gainesville). Nature, 208: 589-90(Nov. 6, 1965).

Electrophysiological examinations were made of more than 100 single and multiple ommatidium preparations from Limulus demonstrated inter- and intra-preparation x-ray sensitivity. The stimulus-response relationship for an x-ray sensitive, dark adapted ommatidium was described. The potentials indicated single unit activity. Optic axon potentials were recorded simultaneously from x-ray sensitive and insensitive receptor units. (H.G.D.)

8608 DIRECT AND INDIRECT EFFECTS OF RADIATION ON PLANT CELLS: THEIR RELATION TO GROWTH AND GROWTH INDUCTION. Holsten, R. D.; Sugii, M.; Steward, F. C. (Cornell Univ., Ithaca, N. Y.). Nature, 208: 850-6(Nov. 27, 1965).

The effects of an irradiated medium on plant cell growth were studied in carrot phloem tissues grown in liquid culture. Components of the liquid culture were a coconut milk growth supplement and a basal medium. Growth of the explants was markedly inhibited by irradiation of either the coconut milk supplement or the basal medium. The effects of γ-radiation on the various components of the basal medium were tested, and it was revealed that the inhibitory effect described was due to an alteration of the sucrose moiety of the culture medium. The products of sucrose radiolysis interacted strongly with the carrot tissue to induce the equivalent effect of direct radiation on the cells. Further, it is shown that products derived for γ irradiation of sucrose can produce chromosomal aberrations in Vicia faba and Tradescantia paludosa of the kind that would normally be ascribed to the direct effects of radiation. (H.G.D.)

8609 ACTIVITY OF INTRACELLULAR PROTEINASES IN RAT SPLEEN AFTER WHOLE-BODY IRRADIATION. Furlan, M. (Nuclear Inst. Jozef Stefan, Ljubljana, Yugoslavia). Naturwissenschaften, 52: 515(1965).

Male rats were exposed to a whole-body irradiation of 600 R from a ^{60}Co source. The animals were killed 3 and 24 hrs after exposure and the activity of the rat spleen proteinases toward different protein substrates was determined. The results show different responses of the proteinases when measured with different protein substrates. (J.S.R.)

8610 MECHANISM OF THE EFFECT OF IONIZING RADIATION ON SODIUM UPTAKE BY HUMAN ERYTHROCYTES. Shapiro, Bernard; Kollmann, George; Asnen, Joel

(Albert Einstein Medical Center, Philadelphia). Radiat. Res., 27: 139-58(Jan. 1966).

The mechanism of sodium uptake and potassium loss in irradiated human erythrocytes suspended in saline and maintained at low temperature was investigated. Measurements were made of sodium uptake in irradiated and nonirradiated erythrocyte suspensions with and without radioprotective agents and under a variety of conditions. Comparisons were made between the effects of radioprotective and sulfhydryl-blocking agents. The distribution of labeled protective agents and a labeled sulfhydryl-blocking agent in erythrocyte suspensions was studied, and the chemical changes in the radioprotective agents during irradiation were determined. (H.G.D.)

8611 THYMINE ADDITION TO ETHANOL: INDUCTION BY GAMMA IRRADIATION. Brown, P. E.; Calvin, M.; Newmark, J. F. (Univ. of California, Berkeley). Science, 151: 68-70(Jan. 7, 1966).

When thymine in dilute, deaerated, aqueous solution was irradiated with γ rays in the presence of ethanol, a high yield of products containing both the thymine and ethanol moieties was obtained. These are shown to be isomers formed by the attack of $CH_3\dot{C}HOH$ radicals at the carbon No. 6 position of thymine. A similar reaction was observed with N,N′-dimethylthymine, but O,O′-dimethylthymine did not react. The reaction may be relevant to the resistance of certain cells to ionizing radiation. (auth)

8612 INVESTIGATIONS ON BIOLOGICAL RADIATION PROTECTION. PART 65. A REPORT ON THE GLUTAMAT METABOLISM IN THE LIVER OF MICE AFTER WHOLE-BODY IRRADIATION. Streffer, Christian; Melching, Hans-Joachim (Univ., Freiburg i. B.). Strahlentherapie, 128: 406-18(Nov. 1965). (In German).

Enzymatic activities of GOT, GPT, and glutamic dehydrogenase in cytoplasm and mitochondria of the liver of starving and fed mice were determined and compared. After total body irradiation with 690 R, the enzymatic activities were not changed considerably up to 12 days after irradiation in the cytoplasm of the starved animals; there was a nonspecific decrease between the 8th and 10th day after irradiation in the mitochondria. A significant increase in GOT activity was observed in the cytoplasm of fed animals between the 1st and 6th day after irradiation with 690 R. The soluble protein content as well as the GluDH activity decreased by about 15% after irradiation of mice with 9000 R. (auth)

8613 EXPERIMENTAL STUDIES OF THE COMBINED EFFECTS OF CHEMOTHERAPEUTIC AGENTS AND X RAYS. Harbers, Eberhard (Univ. Goettingen, Ger.). Strahlentherapie, Sonderbaende, 57: 182-8(1964). (In German).

Effects of chemotherapeutic agents on DNA and RNA are discussed and related to their chemical structure and to various structural components. These effects are illustrated by studies made with ^{14}C- and ^{3}H-labeled metabolites and x irradiation. Differences in effects of actinomycin and 10,000 R of x irradiation in Ehrlich ascites tumor cells indicated that the specific activity of nuclear RNA was reduced as compared to cytoplasmic RNA by actinomycin, but that the x irradiation had a greater effect on the nuclear RNA than on the cytoplasmic RNA. When animals with Ehrlich ascites tumor cells were pretreated with 5-fluorouracil or 1000 R of whole-body x irradiation, or both, and killed, the cytoplasmic RNA concentrations were much less than the nuclear RNA concentrations in the cells from the animals that received the combined treatment. These results are discussed briefly and related to theoretical views of the structure and decomposition of the RNA and DNA molecules. (BBB)

8614 THOROTRAST INJURY IN THE KIDNEY. Seynsche, O. Zentr. Allgem. Pathol. Anat., 103: 161-2 (1962). (In German).

The case history of a 61-year-old man with Thorotrast (ThO_2) deposits in the left kidney is briefly described. About 30 yr prior to the diagnosis, the patient had undergone retrograde pyelography for which Thorotrast was presumably used as a contrast agent. Preoperative x rays showed what appeared to be calcified deposits in the left abdominal region. The surgical specimen presented a shrunken, hard macroscopic appearance, with dilatation of the renal pelvis and stenosis of the upper section of the ureter. Histologic examination showed partly intra- and partly extra-cellular granules of Thorotrast deposited below the epithelium of the renal pelvis, especially in cell-free connective tissue, and in the peripheral layers of the ureter walls. A carcinoma found in the renal medulla was infiltrating the parenchymal tissue. (H.G.D.)

Radiation Effects on Tissues

Refer also to abstracts 8525 and 9346.

8615 (BNL–8818) SEMI-PERMANENT EXTRACORPOREAL ARTERIO-VENOUS AND THORACIC DUCT-VENOUS SHUNTS IN BOVINES. Chanana, A. D.; Cronkite, E. P. (Brookhaven National Lab., Upton, N. Y.). [1964]. Contract AT-30-2-GEN-16. 27p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

Extracorporeal arterio-venous shunts of Tygon and thoracic duct-venous shunts of polyethylene were used for extracorporeal irradiation (E.C.I.) of circulating blood and lymph in calves. With the availability of Teflon cannulae and Silastic tubing it became possible to develop semipermanent extracorporeal shunts. The techniques of making such semipermanent Teflon-Silastic arterio-venous and thoracic duct-venous shunts in calves is described. It is suggested that in addition to using these shunts for E.C.I. of circulating blood and lymph, they can also be used for extracorporeal perfusion of organs and cross circulation studies. (auth)

8616 (BNL–9703) EARLY AND LATE EFFECTS OF 2.2 Gev PROTONS IN MICE AND RATS. Bond, V. P. (Brookhaven National Lab., Upton, N. Y.). [1965]. Contract AT-30-2-GEN-16. 6p. (CONF-651109–17). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

From 1st Symposium on Accelerator Radiation Dosimetry and Experience, Upton, N. Y.

Studies were made on the biological effectiveness of 2.2 Bev protons in mammals. Animals were exposed in a 2.5 cm dia tube (mice), or a 4.4 cm dia tube (rats) containing several animals, with the beam impinging on the presenting area of the forward (proximal to the beam) animal. In the mouse mortality experiments a definite trend to early (3-6 day) deaths was observed, as compared to doses of x rays resulting in comparable 30-day lethality rates. The results suggest that the apparent correlation of the early-death phenomenon with LET may be spurious and that factors other than LET may be responsible. (P.C.H.)

8617 (BNL–9801) EFFECTS OF EXTRACORPOREAL IRRADIATION OF BLOOD AND LYMPH ON HOMOTRANSPLANTATION. Chanana, A. D.; Cronkite, E. P.; Greenberg, M. L.; Joel, D. D.; Schiffer, L. M.; Schnappauf, Hp.; Stryckmans, P. A. (Brookhaven National Lab., Upton, N. Y.). Dec. 10, 1965. Contract AT(30-2)-Gen-16. 34p. (CONF-651208–1). Dep. mn. CFSTI $2.00 cy, $0.50 mn.

From Conference on Lymph and Lymphatic System, New Orleans.

The effects of extracorporeal irradiation of the blood (ECIB) upon skin homograft survival in calves are described. In all ECIB-treated calves, the normally acute and violent skin homograft rejection process was modified to a mild and slow one. Prolongation of skin homograft survival ranged from 1 to 11 days. Combination of ECIB and Imuran given in small non-toxic doses improved results to a slight degree. Prolongation of skin homograft survival in this group ranged from 3 to 20 days. The possible reasons for these results are discussed. Experiments involving

thoracic duct lymph drainage were conducted in nine calves. The procedures for handling the lymph included: extracorporeal irradiation of lymph (ECIL); centrifugation of lymph and return of cell-free lymph to the animal; and pumping of untreated lymph to the rumen in one animal with a thoracic duct-rumen fistule. Only one animal, which was treated by centrifugation and return of cell-free lymph for 10 days, failed to show any prolongation of skin graft survival. Prolongation of survival time of anteriorly placed grafts ranged from 4 to 31 days in 8 calves. Posteriorly placed grafts survived the duration of treatment which ranged from 25 to 68 days in three animals. Implications of the results with particular reference to the different behavior of anterior and posterior grafts are discussed. (auth)

8618 (CONF-631008) PRENATAL IRRADIATION EFFECTS ON CNS DEVELOPMENT AND POSTNATAL BEHAVIOR. Conference Proceedings Held in Washington, D. C., October 4-6, 1963. Werboff, Jack (ed.) (Roscoe B. Jackson Memorial Lab., Bar Harbor, Maine). Contract AT(49-7)-1287. 140p. Dep. mn; CFSTI $4.00 cy, $1.00 mn.

Separate abstracts were prepared on seven papers. (C.H.)

For abstracts of individual papers see: 8619-8625.

8619 (CONF-631008, pp 2-36) REVIEW OF THE SOVIET LITERATURE ON PRENATAL IRRADIATION EFFECTS ON CNS DEVELOPMENT AND POSTNATAL BEHAVIOR. Furchtgott, E. (Tennessee Univ., Knoxville).

Data are reviewed from a number of Soviet studies on the effects of prenatal irradiation on the development of the central nervous system and postnatal behavior. The studies were conducted in dogs and rats exposed in utero to single or fractionated doses of x radiation ranging from 20 to 200 R. Emphasis is placed on the radiosensitivity of the central nervous system of the fetus at various developmental stages and methods used to study the behavior and response to stimuli of animals irradiated in utero. (17 references). (C.H.)

8620 (CONF-631008, pp 37-47) RECENT SOVIET WORK ON ANTENATAL EFFECTS OF RADIATION AND A DISCUSSION OF FUTURE IMPLICATIONS OF GENERAL WORK IN THIS FIELD. Stahl, W. R. (Oregon State Univ., Corvallis).

Data are summarized from recent Soviet investigations on the effects of radiation on the development and function of the central nervous system of animals exposed in utero. The studies were conducted on chick embryos, and dogs, rabbits, and rats exposed to various single or fractionated doses of γ or x radiation at various times during embryogenesis. Conditioned reflex techniques were used to assess central nervous system damage in young and adult animals. Data are included from studies of the transfer of ^{90}Sr from mother to fetus and its effect on central nervous system development in the fetus and morphological effects of radiation in the central nervous system tissues. (30 references.) (C.H.)

8621 (CONF-631008, pp 48-81) PRENATAL IRRADIATION AND DEVELOPING CNS MORPHOLOGY. Brizzee, K. R. (Nebraska Univ., Lincoln).

Pertinent literature on the effects of prenatal irradiation on the morphology of the developing central nervous system is reviewed. Data are included on the effects of single or fractionated doses of x radiation ranging from 35 R to 1120 R on the development of abnormalities in embryos or fetuses of chicks, guinea pigs, mice, rabbits, rats, and salamanders exposed at various stages of embryogenesis. (28 references.) (C.H.)

8622 (CONF-631008, pp 82-91) PRENATAL IRRADIATION AND CNS PHYSIOLOGY AND BIOCHEMISTRY. Hicks, S. P. (Michigan Univ., Ann Arbor).

Results are reviewed from a number of studies on the effects of prenatal x irradiation on the biochemistry, morphology, and physiology of the central nervous system. The studies were conducted in rats and guinea pigs exposed in utero to doses of 200 to 700 R x radiation on the 18th to 22nd developmental day. Electroencephalographic measurements were correlated with cytological studies of the cerebral cortex of rats with thyroid deficiency and those exposed to 200 R x radiation in utero. Animals irradiated at days 17, 19, or 21 showed abnormal electrical activity. The development of enzyme systems, measured chemically and histochemically, in the cortex of guinea pigs was correlated with the development of electrical activity and other functional maturation and biochemical studies were performed on neonatal rats 2 days post partum exposed to 700 R radiation to the head only and examined at varying times during the first 40 days of life. (11 references.) (C.H.)

8623 (CONF-631008, pp 92-110) PRENATAL IRRADIATION AND POSTNATAL BEHAVIOR. Sharp, J. C. (Walter Reed Army Inst. of Research, Washington, D. C.).

Problems involved in the psychological evaluation of animals in which brain damage was produced by prenatal irradiation are reviewed. Results of factor analytic studies of behavior, sensory behavior, and studies of acquisition in rats exposed to doses of 25 to 200 R x radiation on the 16th day of gestation or after exposure of the mother with the abdomen shielded are discussed. (C.H.)

8624 (CONF-631008, pp 111-17) LOW DOSE AND ADMINISTRATION EARLY IN GESTATION EFFECTS. Kaplan, S. J. (Peace Corps, Washington, D. C.).

The standardization of methodology and procedures for animal behavior studies is discussed. Results are reported from a study of the effects of exposure to 5 or 15 R x radiation on the 2nd day of gestation on the maze learning ability of rats at 400 days of age. It was concluded that performance was impaired. When rats were irradiated at 6 or 7 days of gestation with the same dosages, a completely different learning curve was obtained in younger animals. Rats irradiated with 100 R on the 14th or 15th day and differentially handled during the training procedure showed a marked difference in learning ability as compared to animals not treated or handled. Results are included from a comparison of the performance of rats, mice, and hamsters on the Lashley III maze. Differences were found in the performance of the three rodents, sex differences were observed, and analgesic, tranquilizer, and stimulant drugs all affected learning ability. (C.H.)

8625 (CONF-631008, pp 118-26) MEDIATING MECHANISMS OF PRENATAL IRRADIATION EFFECTS. Meier, G. W. (National Inst. of Neurological Diseases and Blindness, San Juan, Puerto Rico).

It is postulated that the effect of prenatal radiation exposure as measured by behavior is not an effect upon the developing nervous system, but results from the effect of irradiation on another organ system of the fetus or on the maternal organism. Data are reviewed from studies on rats exposed to x radiation in utero that support this concept. (C.H.)

8626 (COO-119-233, pp 5-67) INJECTION TABLES. (Utah Univ., Salt Lake City. Radiobiology Div.).

Data are presented on the pathological effects of 5 dose levels of injected ^{239}Pu, ^{226}Ra, ^{228}Ra, ^{90}Sr, and ^{228}Th in dogs maintained until death or until sacrifice becomes a clinical necessity. (C.H.)

8627 (COO-119-233, pp 68-80) AN ANALYSIS OF HEMATOLOGICAL DATA FROM BEAGLES GIVEN ^{226}Ra USING THE RANDOMIZED BLOCK ANALYSIS OF VARIANCE. Dougherty, Jean H.; Mikolaj, Peter J.; Maxwell, Richard (Utah Univ., Salt Lake City. Radiobiology Div.).

The hematological changes following injection of ^{226}Ra into beagles have been followed at 6 month intervals for 120 months after injection using the randomized block analysis of variance and computer calculations using a program written for the IBM-7040-1401. A depression of

leukocyte value occurs in dogs receiving an average of 0.3, 1.1, 3.2, and 10.0 μC/Kg. No hematological changes were found in dogs receiving 0.05 μC/Kg. Red cell values were depressed in dogs injected with 10 μC/kg. (auth)

8628 (COO-1249-3) ULTRAVIOLET INDUCTION AND DIFFERENTIAL PHOTOREACTIVATION OF ZERO-POINT AND DELAYED MUTATIONS OF AN EXTRA-CHROMOSOMAL FACTOR IN YEAST. Pittman, David (Southern Illinois Univ., Carbondale. Dept. of Microbiology). [1963]. Contract AT(11-1)-1249. 9p. (CONF-611-3). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From 4th International Photobiology Congress, Oxford, July 1964.

Ultraviolet-induced mutations affecting an extrachromosomal factor in yeast were found to result from two types of lesions, both presumably in the RNA which governs replication of the factor. One type of lesion, produced in stationary cells prior to onset of nucleic acid synthesis, gives rise to zero-point mutations; this lesion is photoreactivated. A second type of lesion, produced in cells following synthesis of a double complement of nucleic acids, brings about delayed mutations; this lesion is not photoreactivated. It is postulated that different arrangements of the nucleic acid molecules prior to and following replication account for the two types of lesions. (auth)

8629 (LF-28) SELECTIVE SUMMARY OF STUDIES ON THE FISSION PRODUCT INHALATION PROGRAM. Technical Progress Report, July 1964–June 1965. Thomas, R. G. (ed.) (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.). Sept. 1965. Contract AT(29-2)-1013. 283p. Dep. mn; CFSTI $3.50 cy, $1.50 mn.

Thirty-three articles are included; separate abstracts were prepared for 19. The remaining 14 articles include information on instrumentation and computer programs, animal care, and diseases and death of dogs. (P.C.H.)

For abstracts of individual papers see: 8509, 8510, 8550, 8551, 8589, 8630–8640, 8829, 8830, and 9249.

8630 (LF-28, pp 103-7) AUTO-ANTIBODY PRODUCTION IN THE DOG. Meade, G. H.; Sherrod, J. H.; Clapper W. E. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.).

Serum from beagles in which a single kidney had been damaged by x rays was tested for complement fixing and tanned cell hemagglutinating antibodies. E. coli toxin was also administered to two of these dogs. A slight rise in complement fixing antibodies was observed in the irradiated animals. Use of the animal's own kidneys for antigen did not show either type of antibodies in the serum of the dogs from which they had been taken. (auth)

8631 (LF-28, pp 128-30) SURVIVAL OF RATS FOLLOWING INTRAPERITONEAL INJECTION OF ACUTE DOSES OF ^{90}Sr AND ^{137}Cs SINGLY AND IN MIXTURES. Lie, R.; Thomas, R. G. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.).

High levels of various mixtures of ^{137}Cs and ^{90}Sr were intravenously injected into albino rats. Levels in the animals were high enough for the rats to serve as external radiation sources. The first death due to radiation occurred on the fifth day following isotope injection and others succumbed thereafter. Four of the animals are still surviving 138 days following injection. The general physical appearance of all animals at death was one of emaciation. No sex or group differences in isotope retention were apparent. (P.C.H.)

8632 (LF-28, pp 131-8) THE HEMATOLOGIC RESPONSE IN RATS TO INTRAPERITONEAL INJECTION OF MIXED FISSION PRODUCTS, ^{90}Sr AND ^{137}Cs. Jones, R. K. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.).

Comparative biological effects of intraperitoneally administered ^{90}Sr, ^{137}Cs, and mixtures of these two fission products in rats were investigated. All experimental animals showed a profound fall in leukocytes within the first 40 hr to a level ranging from approximately 35 to 40% of pre-exposure values. A progressive depression continued until the ninth day post-exposure when death had occurred in all animals that received a mixture of Sr and Cs. Predictable differences occurred in hematopoietic damage induced by ^{90}Sr and ^{137}Cs. Cesium-137 produced a more detrimental effect on circulating lymphocytes whereas ^{90}Sr manifested a greater effect on granulocytes and erythrocytes. (P.C.H.)

8633 (LF-28, pp 139-48) THE EFFECT OF INHALATION OF FISSION PRODUCTS AND AGING ON THE BEAGLE ELECTROCARDIOGRAM. Redman, H. C.; Weir, J. E. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.).

Data on electrocardigram readings on normal dogs are reported. These data establish a baseline with which variations with respect to radiation exposure and aging can be ascertained. It is probable that any findings differing from these data are indicative of a significant abnormality. (P.C.H.)

8634 (LF-28, pp 149-59) THE EFFECT OF FISSION PRODUCTS AND AGING ON THE ELECTROENCEPHALOGRAMS OF THE BEAGLE. Redman, H. C.; Weir, J. E. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.).

Encephalograms were recorded on beagles prior to exposure to fission products by inhalation and at intervals post exposure. They were obtained in conjunction with a general physical examination to aid in assessing the effects of radiation should these in some measure involve the function of the nervous system. These encephalograms establish a baseline so that any effects of age can be coevaluated with those of radiation if they are encountered. The method used is described in detail. (P.C.H.)

8635 (LF-28, pp 164-208) LONG TERM EFFECTS OF INHALED RADIOIODINE AND RADIOSTRONTIUM IN RATS. Chiffelle, T. L.; Scott, J. K. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.).

The pathology and histology of long-term effects on inhaled ^{131}I and ^{90}Sr in rats are reported. Isotope dosage was planned for levels which would shorten life span by varying lengths, but not generally encroach upon a range leading to an acute radiation syndrome. In the initial pathology evaluation of serially sacrificed animals up to 160 days after inhalation exposure to tracer levels of ^{131}I (0.08 μC/g) there appeared to be minimal but distinct cytologic changes noticeable in the thyroid at 60 days and in the pituitary at 132 days. Also, with ^{131}I, bone and marrow changes were first seen in the 62–160 post-exposure period, after renal changes were noted at 330 days. Results of higher doses are also discussed. Principal pathologic findings in animals receiving ^{90}Sr were marrow depletion, focal incomplete resorption of spongiosa, fibrous dysplasia, osteogenic sarcoma, and leukemia. Obvious tumors of long bones occurred in nearly one-third of the male animals, and histologic studies indicate that microscopic foci of neoplasia are present in many more. (P.C.H.)

8636 (LF-28, pp 230-5) ISOLATION OF VIRUSES FROM BEAGLES EXPOSED TO AN AEROSOL OF ^{90}Sr. Pindak, F. F.; Sanchez, A.; Smith, Anne C.; Brenner, J.; Clapper, W. E. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.).

Eight beagles exposed by inhalation to sublethal amounts of ^{90}Sr and eight controls were sampled by nose, throat, and rectal swabs for the isolation of viruses. Five hundred and eight specimens were taken in the first 5 months. All specimens but 12 from the 3 sources were passed 3 times through monkey kidney cell cultures, most through HeLa cells, and approximately one-half through canine tissue cultures. Forty-three agents were isolated in MK cells and 99 HeLa cells but none from dog tissue cultures. Only nine of these agents were tentatively identified. The nine

appear to be Coxsackie B1 virus. No significant differences at this point were observed between the control and experimental group. (auth)

8637 (LF-28, pp 236-49) BACTERIAL FLORA OF BEAGLES EXPOSED TO ^{90}Sr AEROSOLS. Clapper, W. E.; Rypka, E. W.; Edman, L. A.; Meade, G. H.; Brenner, J. W. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.).

Beagles were exposed to ^{90}Sr aerosols and rectal, nose, and throat swabs were taken in attempts to identify bacterial flora. Thirty-four different species were identified from the nose, 33 from the throat, and 24 from the rectum. There were fewer coagulase negative staphylococci from the noses and more Pasteurella multocida and E. coli isolated from the throats of the dogs. There were also significantly fewer of the irradiated dogs with Micrococcaceae and more with Corynebacteriaceae in their noses. The greatest differences in the carrier rate between experimental and control animals were found in the first month after exposure. These were significant for streptococci and staphylococci in the nose and for streptococci in the throat. (P.C.H.)

8638 (LF-28, pp 250-6) THE SPIROCHETAL POPULATION OF DOGS EXPOSED TO ^{90}Sr BY INHALATION. Pindak, F. F. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.).

Types and numbers of oral and intestinal spirochetes were determined both in dogs exposed to ^{90}Sr by inhalation and in controls. The specimens for oral spirochetes were obtained by swabbing the teeth and gum line and the anterior aspects of the tonsils. In the fecal specimens, the basic three types of spirochetes were found intermittently in most of the dogs. The oral spirochetes were divided into rigid treponemes and longer flexible treponemes. The borrelias and double-contoured spirochetes, common in the fecal specimens, were not found among the oral spirochetes. It was concluded that inhalation of ^{90}Sr at the dosage levels used (31 to 46 μC/kg) had no effect on the spirochetal population of the digestive tract. (P.C.H.)

8639 (LF-28, pp 257-64) HEMATOLOGIC RESPONSE OF DOGS TO AN INHALED SOLUBLE AEROSOL OF ^{90}Sr. Jones, R. K. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.).

The biological response of the hematopoietic system of dogs to an inhaled soluble aerosol of ^{90}Sr was studied. Total white blood count was lowest at four weeks post-exposure and subsequently rose very slowly through the remaining 6 weeks of observation. Neutrophils showed a similar response. Lymphocytes reached a maximum depression two weeks earlier than neutrophils. On the basis of the results it appears that injury to the hematopoietic system is somewhat less when ^{90}Sr is administered by inhalation than by intravenous injection. (P.C.H.)

8640 (LF-28, pp 265-73) INDUCTION OF MYELOGENOUS LEUKEMIA IN RATS BY INHALATION OF A SOLUBLE AEROSOL OF ^{90}Sr. Jones, R. K.; Scott, J. K.; Chiffelle, T. L. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.).

Incidental discovery of myelogenous leukemia in Holtzman rats was made on a group of animals exposed to a soluble aerosol of ^{90}Sr and ^{85}Sr. Two distinct forms of myelogenous leukemia were seen. The first represented by two males and one female was of relatively acute nature, characterized by massive infiltration of the spleen with myeloblasts and myelocytes. The second form of leukemia was seen in only one animal. Ante mortum peripheral blood was available for evaluation and showed a white count of 671,000. The latent period from exposure to development of leukemia was remarkably constant, ranging from 237 to 279 days. Initial whole-body deposition ranged from 490 to 780 μC/kg. (P.C.H.)

8641 (TID-22414) IRRADIATION STUDIES WITH INSECTS INFESTING BULK-GRAIN AND PACKAGED COMMODITIES. Tilton, Elvin W.; Brower, John H. (Stored-Product Insects Research and Development Lab., Savannah, Ga.). Oct. 28, 1965. Contract AT(49-11)-2676. 6p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

Gamma radiation effects on grain beetles and almond moths were investigated. For each treatment, 30 individuals (each in a closed gelatin capsule) of each stage (egg, larva, pupa, and adult) were used for each replicate. Dosage levels included: 0, 10, 20, 30, 50, and 100 krads. Following irradiation, virgin adults were paired with non-irradiated virgin adults from the same original populations for sterility studies. Preliminary results indicated that mortality was high in all stages for all treatment levels. (P.C.H.)

8642 (TID-22493) STUDIES OF THE EFFECTS OF ULTRAVIOLET RADIATION ON CELL STRUCTURE AND BEHAVIOR. Annual Progress Report, November 1964-November 1965. Freed, Jerome J. (Institute for Cancer Research, Philadelphia, Pa.). Dec. 20, 1965. Contract AT(30-1)-2356. 28p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Motile activity of cultured cells was studied with special emphasis on the saltatory motion of cytoplasmic organelles. The results suggest the presence of a system of microtubules distributed throughout the cell cytoplasm, in connection with which rapid particle movements take place. At the same time, uv cytophotometric analyses of living cells were continued, using the vibrating mirror flying spot microscope to measure changes in absorbancy during normal interphase growth and to follow the kinetics of absorbancy decrease after actinomycin blockade of RNA synthesis. The effects on cell multiplication and behavior of a protein fraction from differentiated cells were tested; these proteins are believed to play a role in dye-induced carcinogenesis, and had been postulated to have a repressor-like activity. The experiments demonstrated the inhibitory nature of this protein fraction. Genetic studies of haploid frog cells, resulted in development of a satisfactory cloning technique and other procedures required for isolation of mutants. (auth)

8643 URIC ACID IN NORMAL AND γ-IRRADIATED EGGS OF BOMBYX MORI. Lassota, Zofia (Inst. of Biochemistry and Biophysics, Warsaw). Acta Biochim. Pol., 12: 271-8(1965).

Uric acid content of B. mori eggs, amounting to 3.5 mg./g. of whole eggs remained constant during the diapause as well as during post-diapausal embryogenesis. The irradiation at diapause with 20 kR of γ rays, which inhibited the hatching of larvae, did not influence the uric acid content. Uric acid accumulated in the dead eggs, regardless of the cause of death, only after 10 days of postdiapausal incubation at 25°. (auth)

8644 POSTRADIATION PELVIC FIBROSIS SIMULATING RECURRENT CARCINOMA. Kaplan, Alan L.; Huggins, Philip T.; Wall, John A. (Baylor Univ. Coll. of Medicine, Houston, Tex.). Amer. J. Obstet. Gynecol., 92: 117-24(May 1, 1965).

Fibrosis of pelvic structures following radiotherapy for cervical carcinoma is described in five patients, illustrating the difficulty of distinguishing this postirradiation sequelae from recurrent pelvic carcinoma. The cases show that radiation-induced fibrosis can be responsible for any or all of the usual clinical findings indicative of recurrent cancer. The etiology of fibrosis is tissue damage and is an expected part of the healing process of irradiated tissues. In most of the cases errors occurred in application of radium or in external beam therapy so that tissue tolerance was exceeded, either in total dose or dose rate. In some cases there may have been an altered tolerance to radiation on the part of the patient. Some of the factors that may influence tolerance are age, general health and nutrition, inflammation, and previous pelvic surgery. Problems in the diagnosis of radiation fibrosis are discussed. (TCO)

8645 ANALYSIS OF COMPLICATIONS FOLLOWING MEGAVOLTAGE THERAPY FOR SQUAMOUS CELL CAR-

CINOMAS OF THE TONSILLAR AREA. Grand, Burton P.; Fletcher, Gilbert H. (Univ. of Texas, Houston). Amer. J. Roentgenol., Radium Therapy Nucl. Med., 96: 28-36(Jan. 1966).

Experience with tonsillar radiotherapy in 176 patients is reported. Cobalt-60 external megavoltage beam therapy using five different arrangements was the main feature of treatment. When carcinomas of the tonsillar area were treated aggressively, approximately one-third of the patients developed some form of mandibular complication. There was also a significant incidence of less severe complications. Most of the bone exposures, however, healed with conservative therapy or were self-limiting. Results suggested a decreased incidence of severe mandibular complications when parallel opposing fields were employed. (H.G.D.)

8646 EFFECT OF FOCAL IRRADIATION ON HUMAN BONE MARROW. Lehar, Thomas J.; Kiely, Joseph M.; Pease, Gertrude L.; Scanlon, Paul W. (Mayo Clinic and Mayo Foundation, Rochester, Minn.). Amer. J. Roentgenol., Radium Therapy Nucl. Med., 96: 183-90(Jan. 1966).

The acute effect on hematopoiesis of focal irradiation to bone marrow was evaluated by serial morphologic studies of aspirates from irradiated and from distant marrow sites during radiotherapy of nine cancer patients. In the irradiated marrow, the erythroid line showed marked reduction of early precursors at 400 R and complete disappearance of all nucleated cells at 1,000 R. The granulocytic line did not demonstrate marked reduction of early forms until 1,000 R was delivered; giant granulocytes were most prominent at 1,000 R. Marrow lymphocytes were surprisingly persistent in the irradiated marrow; preservation of lymphocytic foci was noted in histologic sections of marrow at 2,000 R. Monocytes demonstrated cytoplasmic vacuolation at 400 R and tended to persist even at 2,000 R. Megakaryocytes were rarely noted after 1,000 R marrow irradiation. Histologic sections of marrow particles confirmed the hypocellularity of irradiated marrow. Plasma cells and reticular cells proved to be resistant to these doses and were conspicuous in the histologic sections. Consistent changes were not noted in the nonirradiated marrow samples. (TCO)

8647 ON STERILITY AND OTHER INJURIES IN DIOECIOUS MELANDRIUM IRRADIATED WITH X-RAYS AND GAMMA RAYS. Kivi, Erkki I. (Univ. of Helsinki). Ann. Acad. Sci. Fenn. Ser. A IV, No. 56, 96p(1962).

Seeds, shoots, and pollen of Dioecious melandrium species, mainly M. album, were irradiated with different doses of x rays and γ rays from ^{60}Co. The dose range for seeds was 400 to 12,000 R, for shoots the dose was 290 R, and for pollen 1000 to 4000 R. The seeds were irradiated either dry or after presoaking for varying periods in water or 0.03% colchicine solution. Special attention was devoted to fertility in the X_1 and X_2 generations. Irradiation with 12,000 R reduced the germinability of dormant seeds from 86 to 68%. An analysis of the first root-tip mitoses showed that soaking in water for 48 hr did not increase the degree and amount of injury in the first divisions. For male plants the morphologically estimated fertility of the pollen was studied microscopically and the pollen grain diameter measured. A dose as low as 400 R reduced the morphologic fertility of the pollen. The seed yield decreased heavily after irradiation. In the X_2 generation the seed yield improved, compared with the X_1 generation. The improvement was greatest in the 12,000-R lot whose seed yield was nearly the same as that of the lower irradiation lots. The seed yields of the X_1 and X_2 generations showed a correlation similar to that seen in pollen fertility. The seed yield of the X_1 generation depended principally on the irradiation received by the mother plant. However, no difference could be shown in the X_2 seed yield whether the male or the female parent had been irradiated. Little correlation could be shown between seed yield and pollen fertility. Irradiation of shoots with 290 R of ^{60}Co γ rays reduced the fertility of the flowers of shoots that opened subsequently. The lowered fertility manifested itself in flowers that opened 6 or more days after treatment. The fertility of the descendants of females pollinated with such flowers was also low. Fertility disturbances were also noted when mature pollen was irradiated and employed in crossings. Hermaphroditism was noted in the X_1 generation, although in only one plant were all the flowers fully hermaphrodite. Its X_2 progeny showed no hermaphroditism and none of the marked fertility disturbances of the parent plant. In the X_1 generation the excess of females was significant; the same tendency was seen in X_2. Two X_2 progenies comprised females only. This is tentatively attributed to an abnormality of the male parents inhibiting the formation of healthy Y gametes. Otherwise the sex ratio of the material did not differ statistically from the theoretical 1:1 ratio. The results are discussed in terms of changes in radiation sensitivity caused by presoaking, differences between the effect of x and γ rays, chimeric characters of X_1 plants, hermaphroditism, absence of one of the sexes, and the sterilizing effects of irradiation. (BBB)

8648 ULTRAVIOLET INDUCED MUTANTS OF CHLORELLA PYRENOIDOSA. Bendix, Selina (San Francisco State Coll., Calif.); Allen, Mary Belle. Arch. Mikrobiol., 41: 115-41(Jan. 29, 1962).

Chlorella mutants were produced by uv irradiation. Additional strains arose as spontaneous variants in the mutant stocks. Sixty-one of the mutants are described and classified on the basis of pigment content, the effects of light, and stability. The Chlorella strains are compared to other known algal mutants. Hypotheses involving the exchange of genetic information in the Chlorella population are considered. Irradiation may have resulted in mutations of altered environmental requirement(s) for induction of a normally rare sexual phase. The ploidy of Chlorella is unknown, but whether it is haploid, diploid or polyploid, introduction of meiotic random assortment of genes could result in the phenotypic expression of a variety of long-accumulated recessive mutations. (TCO)

8649 OXYGEN CONSUMPTION AND GLYCOLYSIS IN THE AEROBIOSIS OF EMBRYONIC ORGANS IN AN ORGANOTYPIC CULTURE: THE EFFECTS OF X IRRADIATION. Kirrmann, Jean-Michel; le Douarin, Georges (Coll. of France, Paris). Arch. Sci. Physiol., 18: 383-402 (1964). (In French).

Cultures were made of four-day-old chicken embryo hearts and fragments of intestine. The 130 hearts were x irradiated with 3500 R doses, 177 mm of intestine was irradiated with 4500 R and divided into 24 explants, and 646 mm of intestine was irradiated with 7000 R and divided into 88 explants. Samples of all explants were placed in a Warburg apparatus to measure O_2 consumption. Total glucose consumption and tissue N loss were also measured. The results show that while irradiation did not significantly influence glycolysis, it did accentuate the drop in the tissue N level. Irradiation inhibited respiration, but complete recovery was achieved in 30 to 50 hr. Irreversible radioinduced changes, with severity proportional to the x-ray dose, killed some cells, the surviving cells showing normal oxygen consumption. (BBB)

8650 BIOLOGICAL EFFECTS OF RADIATION. Grosch, Daniel S. (Univ. of North Carolina, Raleigh). Bios (Mount Vernon, Iowa), 36: 55-62(May 1965).

The effects of ionizing radiations at the cellular level are discussed, with particular reference to studies using Habrobracon. Advantages of using Habrobracon in cytological studies are presented. Cells differing in radiation vulnerability are present in the ovariole of Habrobracon. Egg production data following a series of x-ray doses are shown. In the developing state the ovariole contents present differentiated, transitional, and primitive cells. Eggs deposited at any time subsequent to exposure may be traced back to the cytological condition of the oocyte or stem cell at the time of treatment. Eggs ready for deposit or large oocytes about to become eggs are unresponsive, short of massive radiation doses, if oviposition is the criterion. Hatchability

is another matter entirely. Just because an egg is laid does not mean that it will hatch. It will not if genetic damage seriously interferes with embryonic development. Problems in the use of ionizing radiations to destroy insect pests are also considered. (TCO)

8651 UNSTABLE CHROMOSOME CHANGES IN TUBERCULIN-STIMULATED LEUKOCYTE CULTURES FROM IRRADIATED PATIENTS. EVIDENCE FOR IMMUNOLOGICALLY COMMITTED, LONG-LIVED LYMPHOCYTES IN HUMAN BLOOD. Nowell, Peter C. (Univ. of Pennsylvania, Philadelphia). Blood, 26: 798-804(Dec. 1965).

Unstable chromosome aberrations (acentrics, dicentrics, rings) were observed in tuberculin-stimulated leukocyte cultures from three patients up to six months after therapeutic irradiation. This is considered evidence that human blood contains immunologically committed, long-lived, nondividing small lymphocytes that retain the latent capacity to proliferate when reexposed to the sensitizing antigen. Immunologic memory may reside in such cells, which, because they are not continually dividing, need not have undergone genetic alteration in becoming immunologically committed. (auth)

8652 FURTHER REPORT ON MUTATION BREEDING OF RICE IN TAIWAN SINCE 1957. Li, H. W.; Hu, C. H.; Woo, S. C. Bot. Bull. Acad. Sinica (Taiwan), 6: 131-41(July 1965).

Twelve varieties of rice were treated with various doses of x rays, γ rays, or thermal neutrons. Tests on mutants for fertilizer response, resistance to rice blast disease, percent yield, and photoperiodism changes are described. (H.G.D.)

8653 IMMUNIZATION OF SHEEP WITH IRRADIATED LARVAE OF DICTYOCAULUS FILARIA. Jovanovic, M.; Sokolic, A.; Movsesijan, M.; Cuperlovic, K. (Inst. for the Application of Nuclear Energy, Zemun, Yugoslavia). Brit. Vet. J., 121: 119-31(Mar. 1965).

Effects of ionizing radiation on larvae of Dictyocaulus filaria were studied and irradiated larvae were used as a vaccine against D. filaria. Viability of irradiated and control larvae was examined in vitro as well as in vivo. The number of moving larvae and their movements per minute were counted in in vitro cultures over a period of 30 days. In in vivo studies, guinea pigs were injected intravenously, 48 hr after larval irradiation, with 2500 larvae each. The number of viable larvae and larval movements/min generally decreased after irradiation as compared with the controls. The most striking decrease was first observed on the larvae exposed to the highest radiation doses (500 kR); however, no dose tested killed all larvae since viable larvae were found in the lungs of guinea pigs even after this dose. Third-stage larvae were exposed to irradiation doses of 20, 40, or 60 kR of x rays and 40 or 60 kR of γ rays. On the fifth postirradiation day 2000 larvae from each radiation dose were administered orally to lambs. The results showed that, out of 2000 nonirradiated larvae, 4.4% developed to parasitic forms in the lungs of lambs, 1% and 0.2% of larvae exposed at 20 kR and 40 kR of x rays respectively so developed, and 0.02% of those exposed at 40 kR of γ rays developed. None of the larvae exposed to 60 kR from either source developed in lambs. There was the marked reduction in the number of male worms and sexually mature female worms. Studies on the radiation effect on larvae of D. filaria showed that larvae survive a radiation dose of 500 kR as indicated by biological tests in guinea pigs; first-stage larvae are more radiosensitive than third-stage ones. Larvae irradiated with the same total dose of x or γ rays yielded almost identical results in treated animals. (BBB)

8654 CONCERNING SARCOMAS PROVOKED BY YTTRIUM AT THE POINT OF INJECTION IN RATS. Graf, B.; Lafuma, J. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses, France). Bull. Ass. Franc. Etude Cancer, 52: 55-62(Jan.-Mar. 1965). (In French).

Male Wistar rats received: 300 or 500 uC $^{90}Sr-^{90}Y$ (as the chloride); 300 or 500 uC ^{90}Y; or 200 ug stable Y. After six months the animals were inspected for tumors. Those that were given $^{90}Sr-^{90}Y$ or stable Y did not develop tumors. However, all rats receiving ^{90}Y developed tumors at the site of injection. The majority of tumors in the group given the 500 uC doses of ^{90}Y were classified as spindle-cell sarcomas. (H.G.D.)

8655 RESTORATION OF CELL DAMAGE PRODUCED BY ULTRA-VIOLET RADIATION. Devoret, R.; Latarjet, R. (CNRS, Gif-sur-Yvette, France). Bull. Inform. Sci. Tech. (Paris), No. 93, 3-6(May 1965). (In French).

Radiation affects living matter through molecular mechanisms that are most important when they are involved at the level of nucleic acids and proteins. The study of the repair processes that occur in living cells after uv irradiation demonstrates the way in which radiobiology has added much to our knowledge of the fundamental genetic mechanisms: mutation and recombination. A deeper understanding of these processes may make it possible to alter the effects of radiation on cells and, ultimately, on organisms. (auth)

8656 IMPROVEMENT OF PLANTS AND IONIZING RADIATIONS. Pereau-Leroy, P. Bull. Inform. Sci. Tech. (Paris), No. 93, 19-26(May 1965). (In French).

The use of ionizing radiation for the improvement of cultivated plants has already yielded interesting results; however, the perfecting of techniques and a better knowledge of the mutation-producing phenomenon should lead to even greater efficiency of the method. Research undertaken in this field by the CEA on the efficiency and mutagenic specificity of γ rays and neutrons and the effects of radiation on periclinic chimeras is described. (auth)

8657 CHROMOSOMES AND RADIATIONS: STUDY OF TWELVE OCCUPATIONALY EXPOSED SUBJECTS AFFECTED WITH RADIODERMATITIS. Mouriquand, C.; Patet, J.; Darnault, J.; Gilly, C.; Jalbert, P.; Wolff, Ch. (CEN, Grenoble, France). Bull. Inform. Sci. Tech. (Paris), No. 94, 3-25(June 1965). (In French).

Chromosomes of twelve occupationally x-ray exposed subjects affected with radiodermatitis of the hands are compared with the chromosomes of normal subjects. The frequency of structural aberrations is much higher with the exposed subjects. Aberrations persist for a long time after irradiation has been stopped. The relation of the observed aberrations with irradiation is discussed as well as the significations of chromatid aberrations. The probability of definitive cytogenetic alterations in some lymphoid areas is discussed. (auth)

8658 SOME ASPECTS OF THE BIOLOGICAL EFFECTS OF HIGH-ENERGY RADIATIONS. Legeay, G. Bull. Inform. Sci. Tech. (Paris), No. 94, 27-51(June 1965). (In French).

After a review of the actual state of knowledge concerning high energy protons and cosmic or accelerated heavy particles, the physical aspect of their action on living tissues is considered. The latter is characterized by the presence of nuclear reactions together with electronic reactions occurring with energies of below 10 Mev. The interaction is not limited to effects involving the incident particle and the atom; whole showers of interactions occur producing neutrons, pions, muons, gammas and electrons. The space distribution of the absorbed energy is of primary importance: it is not the same for a section of the trajectory or for the end of the path of the incident particle. (auth)

8659 MAIN EFFECTS OF IONIZING RADIATIONS ON THE DEVELOPMENT AND GROWTH OF MAMMALIAN EMBRYOS. Tamboise, E.; Tamboise, A. (CEN, Fontenay-aux-Roses, France). Bull. Inform. Sci. Tech. (Paris), No. 94, 53-76(June 1965). (In French).

The effects of ionizing radiation on the development and growth of mammalian embryos are examined in the light of recent experimental work. The radiobiological parameters are affected by the duration of irradiation during organogenesis, the sensitivity of the irradiated species, and individual or specific genetical factors. The effects of the ra-

diations are modified by external or maternal factors. Development accidents are the same for the radiations as for teratogenic agents. The sensitivity of the nucleic acids explains the damage caused to the nucleus, the chromosomes and the cytoplasm. This cellular damage occurs in the development of embryos. Irradiations during pregnancy lead to delayed disorders. The adverse effects on growth produce apparently normal individuals whose weights are inversely proportional to the radiation doses. Retrogression affects each tissue according to a specific radiosensitivity. There can occur disorders affecting the behavior or sexual maturation, a shortening of post-natal survival, and canceration. In man the embryonic effects resemble those found in animals used for experiments. (auth)

8660 THE INFLUENCE OF MUTANT GENES ON CHIASMATA FORMATION IN PISUM SATIVUM. Gottschalk, W. (Univ., Bonn); Villalobos-Pietrini, R. Cytologia (Tokyo), 30: 88-97(Mar. 1965).

Meiotic behavior of two x-ray-induced mutants of Pisum sativum showing reduction of number of chiasmata was analyzed. Dry seeds of the variety Dippes gelbe Viktoria of P. sativum were x irradiated (150-kv, 100 R/min) with 11,000 R. In the X_2 generation the desynaptic mutants No. 19A and 72A arose. During the subsequent generations pure lines of these mutants were produced; furthermore, segregations of the mutant genes were obtained by propagating heterozygotic plants. Cytological findings are presented that were obtained in pure lines of X_6 and X_7 generations. (TCO)

8661 VEGETATIONAL RECOVERY ON ATOMIC TARGET AREAS IN NEVADA. Shields, Lora M.; Wells, Philip V.; Rickard, William H. (New Mexico Highlands Univ., Las Vegas). Ecology, 44: 697-705(Autumn 1963).

The effects of fission-type nuclear detonations on perennial plant cover at the Nevada Test Site were studied. An account is given of denuding and recolonization, by annual species in particular, in the vicinity of seven ground zeros. Observations were made from the close of Operation Plumbbob. An airburst of a 20-kt yield denuded a concentric zone of desert shrub vegetation about 0.5 mi in radius. Selective shock and blast damage to perennials extended asymmetrically to beyond 1 mile in certain cases. During the first recovery year the area within 0.1 to 0.3 mile of ground zeros remained essentially barren until Salsola kali formed a widely spaced summer stand. Cover by spring annuals between 0.4 and 0.8 mile from different tower detonation points exceeded total cover in the control vegetation. One species, Mentzelia albicaulis, contributed the greater part of the cover within 1.0 mile of five tower sites. In the surrounding vegetation Chaenactis steviodes was the predominant annual. A marked decrease in the second-, third-, and fourth-year cover at target areas was associated with a less favorable climatic regime. Chaenactis spp. and Bromus rubens invaded progressively in the direction of ground zeros. Marginal to the denuded areas, certain perennials are recovering by crown sprouting, and weedy shrubs are appearing. Gross damage to vegetation beyond the perimeter of complete denudation, however, appears to be attributable to mechanical and thermal injury. Radiosensitivity of various plant species is discussed. (BBB)

8662 TRANSPLANTATION CHARACTERISTICS AND RESPONSE TO CHEMOTHERAPY OF A MURINE ADRENAL TUMOR. Humphreys, S. R. (National Cancer Inst., Bethesda, Md.); Sato, G.; Goldin, A. Europ. J. Cancer, 1: 125-33(Oct. 1965).

A murine adrenal hormone secreting tumor cell line that had been carried for approximately 15 years in vivo and in vitro was recharacterized for in vivo transplantability and histocompatibility in LAF_1 hybrid mice. Tumor transplants gave 100% growth with no regressions in mice from three suppliers. However, immunity to a second tumor implantation was demonstrated in the presence of growing tumor cells following pre-immunization with x irradiated but still viable tumor cells and also following surgical removal of a large established tumor. Chemotherapy with 6-mercaptopurine or cytoxan retarded tumor growth but failed to significantly increase survival time. Methotrexate was inactive in the system. Urea, 1,3-bis(2-chloroethyl)-1-nitroso-(BCNU) was very effective in reducing the size of the tumor, delaying the development of anemia, leukopenia, and adrenal atrophy, and increasing the survival time of tumor mice. (auth)

8663 THE INDUCTION OF MITOTIC RECOMBINATION BY MITOMYCIN C IN USTILAGO AND SACCHAROMYCES. Holliday, Robin (Univ. of Washington, Seattle). Genetics, 50: 323-35(Sept. 1964).

Vegetative heterozygous diploid strains of Ustilago maydis undergo spontaneous mitotic crossing over at low frequency, but this frequency can be increased up to 100-fold if the cells are treated with uv light. Ustilago does not produce haploid somatic segregants, either spontaneously or after uv treatment. Vegetative Saccharomyces cerevisiae diploids do not haploidize either; their somatic segregation occurs as a result of crossing over and is stimulated by uv. The effects of uv, mitomycin C, and 5-fluorodeoxyuridine on mitotic crossing over in these yeasts was investigated. (C.H.)

8664 GENETIC EFFECTS OF ETHYL METHANESULFONATE AND GAMMA RAY TREATMENT OF THE PROEMBRYO IN MAIZE. Chatterjee, N. K.; Caspar, A. L.; Singleton, W. R. (Univ. of Virginia, Boyce). Genetics, 52: 1101-11(Dec. 1965).

Maize proembryos 24 to 48 hours old were treated with ethyl methanesulfonate (EMS) and gamma rays to study genetic losses of several endosperm (Sh, Bz, Wx) and seedling (V_1, Lg_1, Gl_2) markers. EMS and gamma rays were applied alone and in combination. Losses of the dominant marker genes were used to evaluate the genetic losses induced by these mutagens. Of the endosperm markers, single losses of either Sh or Bz were infrequent, and most of the losses included all the three markers. These multiple endosperm losses were partial rather than whole losses of the entire endosperm. Of the seedling markers, V_1 showed whole losses as well as partial and streak type losses in all the treatments; Lg_1 and Gl_2 showed mostly whole losses increasing with an increase in gamma dose. Multiple treatments with EMS and gamma rays showed losses of multiple endosperm markers, and whole and partial losses of seedling markers. The total rates of loss of the endosperm and seedling markers increased with EMS concentration and time of treatment. With gamma rays, however, only the loss of endosperm markers showed an increase with dose. With multiple treatments, losses of the endosperm and seedling markers, in most cases, increased with the treatment. Seedling markers are lost much more frequently than endosperm markers after EMS treatment but not after gamma ray treatment. (auth)

8665 MUTATION IN DROSOPHILA MELANOGASTER CULTURED ON IRRADIATED FOOD. Rinehart, Robert R.; Ratty, F. J. (San Diego State Coll., Calif.). Genetics, 52: 1119-26(Dec. 1965).

Males and females were cultured on food irradiated with 150, 500, or 3000 kr of X or gamma rays and offspring were tested for dominant, sex-linked, and F_3 lethality. In some experiments, control and irradiated food was stored for three weeks prior to its use. There was no decrease in F_1 offspring survival associated with culturing on irradiated food. There was an approximate twofold increase in sex-linked recessive lethality in the 150, 500, and 3000 kr experiments. This increase can be attributed largely to an increase in gonial mutants. Aging the food prior to use resulted in a decrease in non-gonial mutation; there is still, however, an effect of the irradiated food in increasing lethality above control levels, which was again associated with gonial mutations. F_3 lethality was not detectably increased whether mosaic, F_1 complete, or total F_3 lethality was considered. (auth)

8666 EFFECTS OF ULTRAVIOLET RADIATION ON MAMMALIAN CELLS. II. DIFFERENTIAL UV AND X-RAY SENSITIVITY OF CHROMOSOMES TO BREAKAGE

IN 5-AMINOURACIL SYNCHRONIZED CELL POPULATIONS. Chu, Ernest H. Y. (Oak Ridge National Lab., Tenn.). Genetics, 52: 1279-94(Dec. 1965). (ORNL-P-1451).

Five-aminouracil (5-AU), a pyrimidine analogue, is an effective agent for partial synchronization of mitosis in Chinese hamster cells in vitro. In its presence, DNA synthesis and mitotic activity were heavily suppressed. After removal of cells from the chemical, both activities proceeded synchronously and reached peaks at hours 5 and 8, respectively. The majority of cells seemed to be blocked at the beginning of S. It is possible that cells at different stages of S and G_2 were either stopped or slowed down by 5-AU. The treated cells could apparently recover, then resume and complete DNA synthesis before entering G_2 and division in an orderly manner. There is no evidence, however, for mitotic synchrony in subsequent cycles. Under the experimental conditions, 0.1 chromatid break per cell was observed in 5-AU-treated populations. In terms of mitotic inhibition, cells were more sensitive to ultraviolet light (UV) in S than at G_2, but the reverse was true for x rays. The relationship between mitotic inhibition, chromosome aberrations, and cell killing are discussed. (auth)

8667 RANDOMNESS IN THE FORMATION OF RADIATION-INDUCED CHROMOSOME ABERRATIONS. Heddle, John A. (Oak Ridge National Lab., Tenn.). Genetics, 52: 1329-34(Dec. 1965). (ORNL-P-1406).

The frequencies of x-ray induced asymmetrical and symmetrical exchanges induced in G_1 chromosomes of Vicia have been found to be equal. This is expected if the two types of exchange arise with equal probability from a single chromosomal configuration (site) by random rejoining of broken ends. It is suggested that previous reports of inequality of the frequencies of the two exchange types are a result of scoring artifacts not present in this experiment. The relative frequency with which the M and S chromosomes enter into exchanges is similar for chromosomes and chromatids, the M chromosome being involved less frequently (and consequently the S chromosomes more frequently) than expected on the basis of metaphase length. (auth)

8668 EFFECTS OF IONIZING RADIATION ON THE MYOCARDIUM (EXPERIMENTAL RESEARCH). De Vincentiis, E.; Del Vecchio, E.; De Bellis, E.; Mostarda, G. F. (Univ., Naples). Giorn. Ital. Chir., 19: 351-72(May 1963). (In Italian).

The effect of x rays on the myocardium of rabbits was examined by serum enzyme assays, the electrocardiogram (ECG), and histologic studies. Rabbits were given a local (precordial), 5000 R dose of 250-kv x rays at 112 R/min. This total dose was given either as a single dose, three daily doses every other day, or in 15 daily fractions. Serum glutamic-oxalacetic and glutamic-pyruvic transaminases (SGOT and SGPT) were determined in attempts to detect myocardial injury, but no clear-cut changes in either serum enzyme level were seen. The ECG patterns obtained one, 15, and 20 days postirradiation are illustrated. In the rabbits given 15 fractions for a total of 5000 R, only slight changes were seen. The QRS interval tended to be low initially and the T wave elevated, but these changes disappeared later. More pronounced changes were noted after 5000 R was given in three fractions, and the most marked changes (QRS depression and T elevation) were found after the single 5000 R dose. Histologic examination showed hyperemia and congestion of the pericardium and myocardium. The blood vessels were dilated, their walls edematous, and their serosal layers showed infiltration by inflammatory cells. Some vacuolation and fragmentation of myocardial muscle fibers were seen. Regressive alterations in these fibers were accompanied by incipient connective tissue proliferation and fibrosis. (BBB)

8669 WASTING DISEASE, COOMBS-POSITIVITY, AND AMYLOIDOSIS IN RABBITS SUBJECTED TO CENTRAL LYMPHOID TISSUE EXTIRPATION AND IRRADIATION. Kellum, Michael J.; Sutherland, David E. R.; Eckert, Elke; Peterson, Raymon D. A.; Good, Robert A. (Variety Club Heart Hospital, Minneapolis). Int. Arch. Allergy Appl. Immunol., 27: 6-26(1965).

Thymectomy, appendectomy, or combined thymectomy-appendectomy in the newborn rabbit is often followed by development of Coombs-positive red blood cells and occasionally by Coombs-positive anemia, wasting, and amyloidosis. These animals also have deficient antibody-producing capability and, particularly in those subjected to the combined procedure, defective development of spleen and lymph nodes, and a low level of circulating lymphocytes. These observations led to a comparison of the effects of irradiation on young adult rabbits previously thymectomized, appendectomized, or thymectomized-appendectomized. Intact rabbits given 500-R doses of total-body x irradiation regularly recover immunologic capacity and normal lymphoid tissue structure, and grow and develop normally. By contrast, rabbits subjected to thymectomy or thymectomy-appendectomy in adult life, followed by 500-R irradiation, often develop runting and wasting, Coombs-positive red-blood cells, and amyloidosis. These animals do not recover normal circulating lymphocyte levels or normal structure of spleen and lymph nodes. In many instances these peripheral lymphoid tissues show extraordinary accumulations of reticulum cells and plasma cells, and marked deficiencies of small lymphocytes and lymphoid follicles. In additional experiments designed to evaluate serially the development of amyloidosis and Coombs-positivity, animals were thymectomized and subjected to 500-R total-body x irradiation. Coombs-tests were carried out weekly for 6 weeks after irradiation. Twenty of the 52 thymectomized animals developed Coombs-positive red blood cells between the second and sixth weeks after irradiation, whereas only 4 of 33 control animals showed Coombs-positivity during this period. It is suggested that the basic defect which results in runting, progressive wasting, autoimmune processes, and amyloidosis is a deficiency in the amount and organization of lymphoid tissue in the peripheral lymphoid organs, principally the spleen and nodes. That this peripheral lymphoid tissue defect is less a result of these processes than an etiologic step in their development is suggested by the findings. (BBB)

8670 THE RESPONSE TO CONTINUOUS IRRADIATION OF THE MOUSE LYMPHOMA L5178Y GROWN IN VITRO. Courtenay, V. Doreen (Royal Cancer Hospital, Belmont Sutton, Eng.). Int. J. Radiat. Biol., 9: 581-92 (1965).

A radiosensitive strain of the mouse lymphoma L5178Y grown in vitro was exposed to continuous γ-radiation at dose-rates of 3.0 and 6.3 R/hr. At 6.3 R/hr the number of living cells decreased, but at 3.0 R/hr the culture continued to grow exponentially, although more slowly than normal. Irradiation was continued for a period of over 10 months, during which time the culture showed no signs of deterioration insofar as ability to proliferate was concerned. It was concluded that, for this rapidly dividing culture, there was no accumulation of radiation damage. The radiosensitivity of the culture was tested at $1\frac{1}{2}$ and 3 months from the start of irradiation and was found to be unchanged, but at 6 months the culture had become resistant. Growth-rate measurements on the resistant culture suggested that under conditions of continuous irradiation the cell-cycle time was prolonged. (auth)

8671 EFFECT OF PYRIDOXINE DEFICIENCY IN MICE ON THEIR RADIOSENSITIVITY. van Bekkum, D. W. (Radiobiological Inst. TNO, Rijswikj, Netherlands). Int. J. Radiat. Biol., 9: 604(1965).

Evidence is presented to the effect that mice on a pyridoxine-deficient diet are less radiosensitive rather than more radiosensitive as reported by Veninga and Moore. The reversal is based on the fact that 15% of the females and 7% of the males survive a LD100/30d for the controls, as well as cumulative mortality curves of mice pretreated with desoxypyridoxine. (H.G.D.)

8672 CHARACTERIZATION OF BACILLUS SUBTILIS BACTERIOPHAGES. Brodetsky, Anna M.; Romig, W. R.

(Univ. of California, Los Angeles). J. Bacteriol., 90: 1655-63(Dec. 1965).

A group of six phages, SP5, SP6, SP7, SP8, SP9, and SP13, which use the Marburg strain of Bacillus subtilis as host was characterized. These phages, referred to as group 1, were examined for the following properties: host range, plaque morphology, stability, adsorption kinetics, one-step growth characteristics, calcium requirements, serum neutralization, thermal inactivation, and inactivation by ultraviolet irradiation. Five unrelated B. subtilis phages, SP3, SP10, PBS1, SP alpha, and SP beta, were included in the studies. When first isolated, none of the group 1 phages was able to replicate efficiently on B. subtilis SB19, a mutant of the "transforming" B. subtilis 168. Host range mutants capable of growth in SB19 were isolated for all of the group 1 phages except SP13, and are designated the "star" phages (SP5* through SP9*). For characterization, SB19 was used as host for the star phages, and another B. subtilis mutant, 168B, was host for SP13. (auth)

8673 IONIZING RADIATIONS AND CHROMOSOMES. Moore, Ruth (Radiobiological Research Unit, Melbourne). J. Coll. Radiol. Austral., 9: 272-83(Oct. 1965).

The effects of ionizing radiation on chromosomes is reviewed. Experimental work in the field has been done on species selected for their relatively large chromosomes and for the simplicity of cell cultivation. Most of the work summarized is based on the use of plant material. However, the basic principles of radiation action apply both to plant cells and animal cells. (H.G.D.)

8674 RETARDATION OF DIVISION OF THREE CILIATES BY INTERMITTENT AND CONTINUOUS ULTRAVIOLET RADIATIONS AT DIFFERENT TEMPERATURES. Giese, A. C.; McCaw, B.; Cornell, R. (Stanford Univ., Calif.). J. Gen. Physiol., 46: 1095-1108(May 1963).

Experiments on the comparative effects of the same dosages of continuous and intermittent uv radiation at various temperatures were performed with Colpidium colpoda, Blepharisma japonicum, and Paramecium caudatum. The same dose of uv radiation was found to retard division of these protozoans more effectively when the light is intermittent than when it is continuous, and especially at temperatures of 25 to 35°C. At lower temperatures the difference between the effects of intermittent and continuous radiations was less marked. The data suggest that thermochemical dark reactions succeed the absorption of uv radiations by the cells. In Blepharisma, the cells stop dividing after one or two divisions followed by a stasis. Stasis is marked when the cells are irradiated at higher temperatures but is slight when they are irradiated at low temperatures. Preliminary experiments indicate that the phenomenon is also found in yeasts. (TCO)

8675 METABOLIC ALTERATIONS WITH SENESCENCE OF HUMAN CELLS. EFFECT OF IONIZING RADIATION. Yuan, Grace C.; Little, John B.; Chang, R. Shihman (Harvard School of Public Health, Boston). J. Gerontol., 20: 522-6(Oct. 1965).

This study was undertaken to determine the metabolic alterations resulting from acute radiation exposure in primary amnion cells, and to compare these to the changes associated with advanced chronological age in these primarily postmitotic cells. Acute exposure of primary human amnion cultures to x radiation (1000 R) suppressed mitotic activity, decreased cell density by a constant number per unit time, increased incorporation of cholesterol-26-^{14}C into cell lipids, and depressed incorporation of thymidine-2-^{14}C, and conversion and incorporation of uridine-2-^{14}C into cell DNA, although glycine-2-^{14}C incorporation into DNA was not affected. These changes were characteristic of unirradiated cultures of older postmitotic age. However, the increase in the incorporation of palmitate-1-^{14}C relative to its oxidation to $^{14}CO_2$, which was seen frequently in older cultures, was not detectably altered by irradiation. Thus, these observations confirm that a relation may exist between radiation effects and normal aging in cells. (BBB)

8676 STUDIES ON IMMUNITY IN EXPERIMENTAL LEPTOSPIROSIS: THE IMMUNOGENICITY OF LEPTOSPIRA ICTEROHEMORRHAGIAE ATTENUATED BY γ-IRRADIATION. Hubbert, William T. (Public Health Service, San Francisco); Miller, James N. J. Immunol., 95: 759-64(Oct. 1965).

The possibility of using ionizing radiation to inactivate this organism without impairing its immunogenicity was investigated, with the view of developing a vaccine. Leptospira γ irradiated with 70,000 R or greater failed to multiply in vitro, were rendered non-infectious for guinea pigs, yet maintained their motility in Stuart's medium for 2 to 10 days, the time varying inversely with the irradiation dosage. L. icterohemorrhagiae γ irradiated with 100,000 or 1,000,000 R retained their ability to induce agglutinolysis antibody in both hyperimmunized rabbits and guinea pigs. Of 12 guinea pigs immunized with L. icterohemorrhagiae, γ irradiated with 100,000 R, 11 were protected against both symptomatic and latent renal infection as measured by the absence of positive blood and kidney cultures following challenge. This was in contrast to the formalin-killed, sonically disrupted, and water-soluble vaccines which failed to provide adequate clinical protection. (TCO)

8677 EFFECT OF X RADIATION AND CORTISONE ON MOUSE HEPATITIS VIRUS INFECTION IN GERM-FREE MICE. Vella, Philip P. (Merck Inst. for Therapeutic Research, West Point, Pa.); Starr, Theodore J. J. Infect. Dis., 115: 271-7(June 1965).

Cortisone treatment enhanced mouse hepatitis virus (MHV-1) infection in germfree and conventional mice. Although conventional mice had the same incidence of infection (greater than 90%) as germfree mice, they had a significantly higher mortality (43.4% vs 18%). Both germfree and conventional mice displayed similar recovery trends at 2 and 3 weeks. Whole-body x irradiation enhanced MHV-1 infection significantly in germfree and conventional mice. Both germfree and conventional mice showed similar susceptibility to 200-R and virus challenge after 7 days (69% vs 70% infection, respectively). A 600-R dose plus virus challenge induced a greater mortality in conventional mice (64%) than in germfree mice (8%) initially. However, the trend was later reversed. All virus controls failed to show macroscopic liver damage, and all x-ray-virus deaths were accompanied by severe macroscopic liver damage. The time interval between virus inoculation and x-ray challenge was not important. The greater susceptibility of germfree mice to 600-R doses plus virus challenge after two weeks may be due to additive but unrelated effects of irradiation. Germfree mice pretreated with either triolein or endotoxin became more resistant to a cortisone-virus challenge. This increased resistance is attributed, in part, to a hyperactive reticuloendothelial system (RES). Since the RES is underdeveloped in germfree mice, results indicate that conventional mice are better equipped to survive a 600-R + virus challenge. Because of the immediate increase in susceptibility of germfree and conventional mice to an x-ray + virus or cortisone + virus challenge, the macrophage response is probably of major importance in eliminating mouse hepatitis virus from its host. (TCO)

8678 AN ULTRASTRUCTURAL STUDY OF NUCLEOLAR ENLARGEMENT FOLLOWING ULTRAVIOLET IRRADIATION OF HUMAN EPIDERMIS. Nix, Thomas E. Jr.; Nordquist, Robert E.; Scott, J. Randolph; Everett, Mark Allen (Univ. of Oklahoma Medical Center, Oklahoma City). J. Invest. Dermatol., 45: 114-18(Aug. 1965).

Ultraviolet light-induced nucleolar changes in human epidermis were studied by electron microscopy, permitting precise measurements of nucleolar size as well as observations of qualitative changes. Four times the minimal erythema dose of mercury vapor irradiation filtered through 2 cm of water was administered to the left lumbar area of a normal 24-year-old white male, and biopsy specimens were obtained from the irradiated site and symmetrical control site at intervals of 1, 3, 12, 72 hr and 1 week. Light mi-

croscopy revealed that nucleolar size was increased in the 72-hr postirradiation skin sample when compared with control skin. Electron microscopy also revealed a marked increase in size of nucleoli in the spinous layer of the epidermis 72 hr postirradiation. Statistical analysis of the size of the 72-hr irradiated and control nucleoli showed this increase to be significant. Attempts were made to determine whether the nucleolar enlargement observed was a sign of (1) increased metabolic activity, (2) metabolic block with accumulation of materials in the nucleoli, or (3) nucleolar degeneration. (TCO)

8679 THE EFFECT OF VITAMIN C-FREE DIET, HYPERVITAMIN C AND B_{12} ON ASCITES HEPATOMA AND THEIR RESPONSE TO RADIATION. Suvanasuthi, Rojana; Prijyanonda, Banyat. J. Nat. Res. Counc. Thailand, 3: 225-38(Dec. 1962). (In Siamese).

The effects of diet on ascites hepatoma (AHS) in rats were studied in animals given: a vitamin C free diet, a hypervitamin C diet, or a hypervitamin B_{12} diet. Mean survival time served as the criterion of response. Further experiments were performed to determine the effects of such diets on the radiosensitivity of ASH cells. Animals in the second group were given 1000 rad doses of x rays over a period of 5 days. Statistically significant differences were not found between nonirradiated and irradiated groups. However, mean survival time was longer in irradiated rats fed control diets than in those given the experimental diets. (H.G.D.)

8680 EFFECTS OF IONIZING RADIATION IN CHILDREN. Sutow, Wataru W. (Univ. of Texas M. D. Anderson Hospital and Tumor Inst., Houston); Conard, Robert A. J. Pediat., 67: 658-73(Oct. 1965).

This review, referring to 162 articles in the recent literature, considers radiation effects in human beings, particularly the effects on children. Although some radiation effects have been shown to be greater in the young humans, there is no good evidence for increased sensitivity to any radiation effects in children as compared to adults. This is based on data involving relatively high doses of radiation; no positive statements can be made in regard to low dose effects. Effects of radiation are reviewed in terms of the sources of low-level irradiation: natural background, fallout from nuclear test explosions, industrial uses of radiation, and medical uses of radiation. Some epidemiologic studies have reported increases in rate of development of leukemia and malignant neoplasia among children exposed in utero to diagnostic doses of radiation, but not all data support this finding. However, reports of correlation of radiation exposure and later development of malignancies call for much more cautious use of radiation in both diagnostic and therapeutic procedures. (TCO)

8681 MYOCARDIAL INFARCTION FOLLOWING RADIATION. Dollinger, Malin R.; Lavine, Daniel M.; Foye, Laurance V. Jr. (Veterans Administration Hospital, San Francisco). Lancet, 2: 246(July 31, 1965).

A patient is described who received radiation therapy to the lower mediastinum and esophagus for Hodgkin's disease and who developed an acute inferior myocardial infarction at the age of 31, two months following radiation. In subsequent years he developed angina pectoris and congestive heart failure. The age of the patient, lack of a family history of coronary artery disease, absence of significant atherosclerosis elsewhere, normal serum cholesterol, and interval between radiation exposure and myocardial infarction make it most probable that the fibromuscular proliferation within the coronary arteries was due to the radiation therapy. The heart was exposed to the same radiation dose as the mediastinum and esophagus (1440 R). (TCO)

8682 MYOCARDIAL INFARCTION FOLLOWING RADIATION. Prentice, R. T. W. (Western Infirmary, Glasgow). Lancet, 2: 388(Aug. 21, 1965).

A case is described wherein thoracic radiotherapy was believed to have caused fatal coronary artery disease. The 19-yr-old boy, who died of acute heart failure, had received 3250 R at age 15 for intrathoracic glandular enlargement from a lymphoma of the Hodgkin group. Although it was not possible to postulate a direct causal relation between radiotherapy and severe coronary artery disease in this case, it was felt that the association of these two events in a young man of this age is significant. (BBB)

8683 MYOCARDIAL INFARCTION FOLLOWING RADIATION. Feher, J. (Univ. Medical School, Budapest). Lancet, 2: 643-4(Sept. 25, 1965).

Two earlier reports are reviewed and a new case is reported wherein radiotherapy to the thoracic region was followed by myocardial infarction. The new case concerns a 69-year-old male patient treated for lung cancer over a period of three months. Progression of the injury is described. A causal relationship between the radiotherapy and the development of myocardial infarction was suggested. (TCO)

8684 ULTRASTRUCTURE OF THE LUNG 100 DAYS AFTER IRRADIATION. Bellion, B.; Garbagni, R.; Chiarle, S. (Univ., Turin). Minerva Nucl., 9: 136-7(May-June 1965). (In Italian).

Rabbits were irradiated over the anterior wall of the chest with a single dose of 4000 R x radiation. Examination of the ultrastructure of the lung 100 days after irradiation revealed the presence mainly of connective tissue changes characterized by a considerable development of the collagen fibrils in the alveolo-capillary wall. (tr-auth)

8685 AMINO-ACIDS OF WALLS OF MICROCOCCUS RADIODURANS. Work, Elizabeth (Twyford Labs., London). Nature, 201: 1107-9(Mar. 14, 1964).

Chemical and electron microscopic investigations were conducted in an attempt to relate structural and chemical characteristics with the ability of Micrococcus radiodurans to survive large doses of ionizing radiation. Micrococcus radiodurans is a radiation-resistant tetrad-forming coccus which, although staining as a gram-positive bacterium, has many properties atypical of this group. For example, the cell walls contain a high proportion of lipids, and show structural lipoprotein layers similar to those found in gram-negative organisms. An investigation was made of the amino acids of that portion of the cell wall of M. radiodurans which is solubilized by lysozyme. (TCO)

8686 CONTINUOUS IRRADIATION OF HeLa CELLS AT −196 deg C. Nias, A. H. W.; Lajtha, L. G. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Nature, 208: 400-1(Oct. 23, 1965).

HeLa cells in log phase were cooled down to −196°C in a liquid nitrogen refrigerator and continuously irradiated at two different dose rates to total doses of 1000 or 2000 rads. After incubation for 10 days at 37°C, the colonies were scored. Although surviving fractions were lower than controls irradiated at 37°, the only fractions that were significantly different were those after the 2000 rads total dose given over 20 days at 100 rads/day. It is concluded that large total doses of continuous β irradiation have very little effect on HeLa cells at −196°C. (H.G.D.)

8687 APPARENT SUPPRESSION OF MUTATION RATES IN BACTERIA BY SPERMINE. Johnson, H. G.; Bach, M. K. (Upjohn Co., Kalamazoo, Mich.). Nature, 208: 408-9(Oct. 23, 1965).

Evidence is presented that the inclusion of spermine in bacterial culture media results in a significant decrease in the random mutation rate of Escherichia coli and Staphylococcus aureus. The mutational events that were investigated were the one-step development of resistance to streptomycin and the back mutation to autotrophic growth by a tryptophan-requiring mutant. There was no effect on the growth of streptomycin-sensitive or -resistant organisms when spermine was included in the culture medium. It is concluded that the antimutagenic action of polyamines is a general property of caffeine and spermine, that it is independent of the mutational end-point being measured, and that it is even more pronounced when mutations are uv-induced than when randomly occurring. (H.G.D.)

8688 INFLUENCE OF OXYGEN AND CYSTEINE ON THE RADICAL STATE OF X-IRRADIATED LYOPHILIZED LIVER. Abe, Mitsuyuki; Moenig, Hans; Koch, Ruprecht (Univ., Freiburg i. B.). Nature, 208: 499-500(Oct. 30, 1965).

Investigations of x-irradiated mouse liver are described. The study also includes preparations of liver in which solutions of cysteine were injected before freeze-drying. The ESR spectra of the x-irradiated lyophilized liver treated with cysteine and ESR spectra of the untreated liver are shown. An admission of air to the substances irradiated under vacuum leads to a change in the ESR. These investigations show that atmospheric oxygen is able to induce a radical shift without external energy feed. (J.F.P.)

8689 "CELL KILLING" IN RADIOBIOLOGY. Robinson, D. M. (Medical Research Council, Harwell, Eng.). Nature, 208: 500(Oct. 30, 1965).

The use of the term "cell killing" is suggested for the loss of the reproduction capability of an irradiated cell. It was shown by the previous users of this terminology that the term "cell killing" had long had a specific meaning in microbiology, referring only to the ability of an individual cell to produce a macroscopic colony. The use of a standard phrase in all reports of radiobiological investigations involving single cell plating techniques would be helpful in avoiding ambiguity. (J.F.P.)

8690 RADIATION-INDUCED SEX REVERSAL IN ECBALLIUM ELATERIUM. Gomez-Campo, Cesar; Casas-Builla, Manuel (Instituto Nacional de Investigaciones Agronomicas, Madrid). Nature, 208: 805(Nov. 20, 1965).

Hybrids of the cucurbitous plant Ecballium elaterium were treated with γ rays, neutrons, or diethyl sulfate for the purpose of producing mutations. A number of sex aberrations were noted that were clearly not mutations but probably originated from disturbances in the mechanisms concerned in sex phenotype expression. Some new characters not affecting sex also appeared. One instance of a sex reversal, probably of genetic origin, was detected in a masculine plant that arose from a neutron-irradiated seed. Although flower morphogenesis reached a quite reversed expression, the aspect of the inflorescence remained essentially masculine. Female flowers on the reversed branch produced parthenocarpic fruits. (H.G.D.)

8691 ACUTE RADIO-SENSITIVITY AS A FUNCTION OF AGE IN MICE. Spalding, J. F.; Johnson, O. S.; Archuleta, R. F. (Los Alamos Scientific Lab., N. Mex.). Nature, 208: 905-6(Nov. 27, 1965).

Variations in sensitivity to single acute x ray exposures were studied in different age groups of mice. Radioresistance increased with age from 3.6 weeks, reaching maximum resistance at 13 to 17 weeks. Resistance declined from 18 to 20 weeks throughout the remainder of the life span. There was no apparent period of relative stability in radioresistance with the acute dose as compared with the fractionated dose. Death in mice given acute doses was a result of damage to physiological functions different from those damaged in animals given fractionated doses. (H.G.D.)

8692 THE ACTION OF GAMMA IRRADIATION ON THE VARIABILITY OF SOME QUANTITATIVE CHARACTERS IN MAIZE. Balint, Andor; Sutka, Jozsef (Agrartudomanyi Egyetem Noevenynemesitestani Tanszek Goedoelloe, Hung). Novenytermeles, 14: 67-72(1965). (In Hungarian).

The inbred C5 strain of maize was γ irradiated at 5000 or 15,000 R and tested for mutations two weeks later. The variability of plant height was influenced by the 5000 R dose both in the positive and negative direction. The spread in plant height was 22.30 cm in test plants as compared to 16.20 in the control group. The larger γ dose also affected height variability, but to a much less degree. Average increases of 1.01 cm in length and 13 g in weight were found in ears of plants receiving the lower dose. Greater variations in protein and oil content were also observed in the lower dose group. It was concluded that 5000 R γ doses act as mutagens rather than as stimulants in maize. (H.G.D.)

8693 EXPERIMENTS ON THE INDUCTION OF POLYGENIC MUTATIONS WITH SUCCESSIVE IRRADIATION IN RICE. Jalil, M. A.; Yamaguchi, H. (Tokyo Univ.). Phyton (Buenos Aires), 21: 149-55(1964).

The comparative effects of single and successive irradiation, the latter with and without selection, were studied on the induction of mutations for quantitative characters (grain size) in rice. Seeds of Norin No. 29 variety (moisture content 12%) were exposed to 10 kR doses of γ rays from a ^{60}Co source. The seeds were first treated in 1958 and grown in bulk in the field. From each 10-kR first generation (X_1-10) plant, four early appearing fertile ears were harvested. One seed was taken at random from each ear, bulked and sown to raise the X_2-10 generation. Similarly one seed removed at random from each ear was pooled and irradiated again with 10 kR in 1959 to get $X_{1/2}$-10 generation. For both X_2-10 and $X_{1/2}$-10 generations, the seeds were space-planted in the field in randomized block design. In 1960, similar procedure and experimental design were repeated to produce $X_{2/3}$-10 as well as $X_{1/2/3}$-10 plants. One seed was removed at random from $X_{1/2/3}$-10 plant and the seeds were space-planted in randomized block to get $X_{2/3/4}$-10 generation. For 30-kR irradiation, the same procedure as that of 10 kR was followed. The results demonstrated that all the populations fitted the normal distribution curve except $X_{2/4}$-10-S population which showed negative skewness. The results of the analysis of variance in the selection for long and short grains show that the mean value for the length of nonirradiated control population did not change from that of nonirradiated control population without selection. On the other hand, in all the treated populations the mean values deviated significantly from that of the nonirradiated controls towards the desired direction. (BBB)

8694 ADRENAL HEMORRHAGIC EFFECT OF THOROTRAST. Mosley, Wiley H.; Cluff, Leighton E. (Johns Hopkins Univ., Baltimore). Proc. Soc. Exp. Biol. Med., 120: 774-80(Dec. 1965).

Thorotrast administered intravenously was shown to produce bilateral adrenal hemorrhage in rabbits. This effect is directly related to the dosage of Thorotrast employed, and is more frequently observed in larger rabbits than in small rabbits. Adrenal hemorrhage was dependent upon the particulate material in Thorotrast (thorium dioxide) and was not produced by the dextrin medium alone. The possible role of at least three demonstrated activities of Thorotrast is discussed: adrenal stimulation, production of multiple coagulation defects, and vascular wall injury. (auth)

8695 PERCEPTION OF ODDITY BY MONKEYS AS A FUNCTION OF AGING AND RADIATION. Davis, Roger T.; McDonald, Arthur L. (Univ. of South Dakota, Vermillion). Psychol. Rep., 11: 383-6(Oct. 1962).

The hypothesis that the chronic effects of whole-body radiation mimic changes in behavior that accompany aging was investigated in monkeys. Fourteen rhesus monkeys were used. Nine were 11 to 12 yr of age and had considerable experience solving oddity problems. The remaining five were aged 3.5 to 5.5 yr. Four of the old monkeys were survivors of experiments on the effects of whole-body irradiation with x rays and each had received 1100 R in three doses within a period 6 to 8 yr prior to the experiment. The other old monkeys served as nonirradiated controls and had training that was nearly identical to that received by the irradiated group. Stimuli were presented on a stimulus tray with three foodwells. The stimuli were 14 wooden cylinders of varying height. The perception of a shift in the oddness in a situation with three stimuli was studied. The procedure was essentially the psychological method of bisection. Old irradiated monkeys shifted when the variable object was about half the height of the tall standard object. Old nonirradiated monkeys shifted when the variable was more nearly half the distance between the tops of the short and tall standards. The results are discussed as providing further evidence of the difference in scope of attention of irradiated and nonirradiated monkeys and not what would be

predicted from the hypothesis that aging and radiation effects are identical. Thus a feature of the whole-body radiation syndrome is a reduction in the animal's scope of attention. (TCO)

8696 THE INFLUENCE OF HYDROGEN ION CONCENTRATION ON RADIATION-INDUCED DAMAGE IN BARLEY. Mohan Rao, P. K.; Konzak, C. F.; Nilan, R. A.; Dhesi, S. S. (Washington State Univ., Pullman). Radiat. Bot., 5: 455-63(Dec. 1965). (TID-21976).

Resting seeds (14% moisture content) of barley (Hordeum vulgare var. Himalaya) were gamma irradiated and then hydrated in buffer solutions at different pHs for 12 hr at 20°C. The response of the irradiated seeds to hydrogen ion concentration of the hydration solution was measured by several biological criteria. A modification of the radiation-induced damage as measured by M_1 seedling growth injury, lethality, and mitotic chromosome aberrations was found. The general trend was a decrease in radiation-induced damage with an increase in the pH of the hydration solution. In contrast, the frequency of radiation-induced M_2 seedling mutations and M_1 plant sterility were influenced but little. Mutagenic efficiency, i.e., the ratio of mutations to amount of damage e.g., seedling injury, mitotic chromosome aberrations, and lethality, induced by gamma radiation, was greater at basic pHs than at acidic pHs. It was hypothesized that hydrogen ion concentration might influence the radiation-induced chromosome aberration frequency by either modifying the properties of radiation-induced radicals responsible for the induction of chromosome breaks, or by altering the activity of enzymes concerned with the development and/or subsequent behavior of chromosome breaks. The latter mechanism is favored. (auth)

8697 COMPARISON OF THE DEVELOPMENTAL RESPONSES OF DIPLOID AND TETRAPLOID PHALARIS FOLLOWING IRRADIATION OF THE DRY SEED. I. DETERMINATION OF MITOTIC CYCLE TIME, MITOTIC TIME AND PHASE TIME. Prasad, A. B.; Godward, M. B. E. (Queen Mary Coll., London). Radiat. Bot., 5: 465-74(Dec. 1965).

The duration of G_1, S, G_2 and mitotic cycle (i.e., interphase + mitosis) times and phase times (i.e., duration of prophase, metaphase, anaphase, etc.) were compared in the diploid Phalaris canariensis and the tetraploid P. minor. Using the technique of autoradiography with tritiated-thymidine as a DNA precursor, the mitotic labeling index method was employed to estimate G_1, S, and G_2. This, together with a method of cell counting and growth measurement, was also used for determining the mitotic cycle time and phase times. The only observable difference between the two species was the length of S, which was twice as long (6.4 hr) in the tetraploid as in the diploid (3.4 hr). (auth)

8698 BIOLOGICAL DISCRIMINATION OF DIFFERENCES IN NATURAL BACKGROUND RADIATION LEVEL. Mericle, L. W.; Mericle, R. P. (Michigan State Univ., East Lansing. Univ. of Colorado, Boulder). Radiat. Bot., 5: 475-92(Dec. 1965). (COO-1400-4).

Variations in terrestrial radiation level have generally been dismissed as too small to constitute an important differential for the biota. Yet within a plant population indigenous to a radioactive dike near Central City, Colorado, morphological abnormalities occur more frequently in clones from sites of higher radioactivity. This observation prompted experiments to test the ability of the highly radiosensitive plant, Tradescantia, to discriminate between the levels of radiation present at the dike, in the absence of any contribution from possible radio-chemical absorption by the plant roots from the dike soil. Plants of a hybrid Tradescantia (clone 02), heterozygous for flower color, were scored for the base-line (spontaneous) somatic mutation rates at Science Lodge, Colorado (background radiation level, 0.05 mR/hr). When these plants were moved to the radioactive dike for a 2-week exposure at a radiation level of 0.25 mR/hr, the frequency of mutant sectors increased 4 to 5 fold and that of morphological anomalies of the floral apparatus rose nearly 9-fold. Subsequent growth chamber studies using the same clone confirmed the mutagenic effectiveness of an equivalent change in radiation level induced by ^{60}Co irradiation. Two groups of plants from the Tradescantia 02 clone were first matched for number of flowering clusters and base-line mutation rate at Science Lodge, then were exposed to the radioactive dike for 4 weeks at radiation levels of 0.10 and 0.25 mR/hr. The somatic mutation rates in both groups of clusters at the dike rose above the rates exhibited at Science Lodge, then declined in conjunction with adverse weather conditions. In flower clusters of the same age, exposure to 0.25 mR/hr produced a significantly higher frequency of somatic mutations than 0.10 mR/hr. Differences in base-line mutation rates and slopes of the radiation response curves from the three studies, however, imply that factors other than radiation can also play important modifying roles. (C.H.)

8699 COMPARATIVE EFFECTS OF X-RAY AND U.V. IRRADIATIONS ON POLLEN GERMINATION AND GROWTH. Brewbaker, J. L.; Espiritu, L.; Majumder, S. K. (Univ. of Hawaii, Honolulu). Radiat. Bot., 5: 493-500(Dec. 1965).

Comparative studies were made of the inhibition of pollen germination and growth by x rays and germicidal uv light. Thirteen flowering plant species were chosen for the diversity of pollen types they represented. LD_{37} doses (incident exposures) of uv ranged from 16 to 107 × 10^6 ergs/cm^2. LD_{50} doses of unfiltered x rays (2 mev peak) ranged from 350 to 1200 krad. The two sets of data were not correlated, nor were they correlated with any cytogenetic characteristic of the pollen types. Ultraviolet killing curves were entirely exponential (avg. extrapolation number = 0.98) while x ray killing curves were wholly sigmoidal (avg. extrapolation number = 34.4). It is proposed that, in contrast to x rays, 2537 Å uv kills the haploid pollen cell by inactivating a single gene. (auth)

8700 THE EFFECT OF IONIZING RADIATION ON THE FLORAL VASCULARIZATION OF COLEUS BLUMEI BENTH. Hillson, C. J.; Dunkle, A. R. (Pennsylvania State Univ., University Park). Radiat. Bot., 5: 501-5 (Dec. 1965).

The floral vascularization of 21 flowers, taken in three collections from a Coleus plant irradiated with a cesium-137 source for 25 hr at a dosage of 200 R/hr, was compared with the vascularization of flowers removed from the plant prior to treatment. In the first collection after treatment only the vascular traces to the gynoecium were affected. In the second collection traces to sepals, petals, and stamens, as well as the carpellary traces, were affected. The third collection showed no effects. The most frequent alteration of the floral stele involved the vascularization of accessory ovules and nectaries. (auth)

8701 INACTIVATION OF ALGAE CELLS WITH X-RADIATION. Faehnrich, P. (Univ., Cologne). Radiat. Bot., 5: 507-12(Dec. 1965). (In German).

The effect of x radiation on colony formation of cells of the green algae Chlorella, Chlamydomonas, and Euglena was studied. The inactivation curves obtained corresponded to multi-hit dose-response curves. Post irradiation incubation of cells on supplemented medium did not result in any increase in number of viable cells. Radiation induced color variants and colony mutants were obtained from Chlorella pyrenoidosa. (auth)

8702 TWO KINDS OF CHROMOSOME REJOININGS IN X-RAYED TWO-ROWED BARLEY. Ichikawa, Sadao; Ikushima, Takaji; Nishiyama, Ichizo (Kyoto Univ.). Radiat. Bot., 5: 513-23(Dec. 1965).

In order to determine whether or not some rejoining of broken ends of chromosomes occurs within a matter of seconds after irradiation, x-ray irradiation was performed on the seeds of two-rowed barley presoaked for 24 hr, changing the exposure and the dose rate or fractionating the exposure. All the exposures or dose rates used were measured simultaneously with or immediately before the treatments, and all the exposure times and

the intervals in fractionation experiments were accurately measured. In each lot, the frequency of induced dicentric bridges was scored at anaphase of the first mitotic division in 2000 to 6700 cells fixed 48 hr after the start of presoaking. All the experiments were carried out at 20 ± 1°C. The frequency of dicentric bridges increased with exposure, giving a curve close to square-of-exposure, and effects of dose rate and of fractionation were clearly observed. It was also made clear that there are two kinds of x-ray induced chromosome breaks, one of which can rejoin within an extremely short period such as 20 to 30 sec after irradiation, and another can rejoin after a longer time such as 15 to 30 min. The latter breaks were induced about 20 percent more frequently than the former breaks. From the experiment using DNP, it was presumed that the energy required for rejoining is supplied from oxidative phosphorylation. (auth)

8703 STUDIES ON THE EFFECT OF CHRONIC GAMMA RAYS ON RICINUS. I. DEVELOPMENT OF POLLEN, OVULE AND FEMALE GAMETOPHYTE. Singh, R. P.; Gunckel, J. E. (State Univ., New Brunswick, N. J.). Radiat. Bot., 5: 525-42(Dec. 1965).

Young seedlings of Ricinus communis at the three-leaf-stage of growth were put in the gamma greenhouse at approximate dose rates of 500, 400, 300, 200, 100, 50, and 25 R per day (exposure period of 22 hr/day) for varying periods of time. Plants at 500 R/day did not produce any inflorescences due to growth inhibition. At 400 R/day the inflorescences formed were extremely reduced and non-viable. At 300 R/day and lower doses the flowers in the florescence were usually unisexual, male at the base, intergrades in the center and female at the top. At chronic doses of 100 and 200 R/day terminal hermaphrodite flowers were produced occasionally and in about 5 to 10 percent of the plants at 300 and 400 R/day. Morphogenetic abnormalities described were dose related. (C.H.)

8704 RESPONSE OF TRIFOLIUM SUBTERRANEUM TO X-RAYS AND THERMAL NEUTRONS. Brock, R. D. (CSIRO, Canberra, Australia). Radiat. Bot., 5: 543-55 (Dec. 1965).

Sensitivity of Trifolium subterraneum to x rays and thermal neutrons was influenced by radiation dose, genotype, and seed size. Moisture content of seeds also influenced sensitivity to x rays. Plants grown from large seeds at low moisture content were least damaged in the M-1 generation. Visible mutations induced by x rays and thermal neutrons affected a wide range of characters and in one case the variation transcended that occurring within the species. Mutation frequency increased linearly with dose, with some saturation at high doses. Total mutation frequencies of up to 1.28 per treated seed were recorded in the M-2 generation. Scoring of M-2 mutation frequencies underestimated the total mutation frequency, in this case by approximately 13 percent. Progenies from heterozygous M-2 plants revealed a surprisingly high frequency of dominant mutants. Relative biological efficiency of thermal neutrons varied from over 20 for M-1 damage to ≃14 for morphological and quantitative mutations. As RBE values for gene or point mutations in other organisms approach unity these high values indicate that virtually all the mutations observed were the result of chromosome breakage. (auth)

8705 CORRELATION OF INTERPHASE CHROMOSOME VOLUME AND REDUCTION OF VIABLE SEED SET BY CHRONIC IRRADIATION OF 21 CULTIVATED PLANTS DURING REPRODUCTIVE STAGES. Yamakawa, Kunio (Inst. of Radiation Breeding, Ohmiya, Japan); Sparrow, Arnold H. Radiat. Bot., 5: 557-66(Dec. 1965).

The purpose of these experiments was to look for a relationship between average interphase chromosome volume (ICV) and radiosensitivity based on a 50 percent reduction in production of viable seeds. Actively growing plants of twenty species were exposed chronically (5 to 300 R/day) to a ^{60}Co gamma source. The durations of the exposures varied but most exceeded 2 months; thus all stages from flower bud differentiation to seed maturity were exposed. The average interphase chromosome volumes of these species were obtained by dividing the interphase nuclear volume of vegetative meristems by the chromosome number of the particular species. The exposure rates reducing seed productivity to 50 percent of the unirradiated controls ranged from 18 to 280 R/20 hr day, while ICVs ranged inversely from about 38.2 to 3.2 μ^3. The data indicate a clear inverse relationship between ICV and exposure rate required to reduce yield of viable seed by 50 percent. This inverse relationship is in agreement with earlier results which showed a similar relationship between ICV and other radiobiological end points. A comparison of the regressions for 50 percent viable seed production and slight growth inhibition indicated that approximately one-half the daily exposure required to produce a slight effect on growth was sufficient to reduce viable seed production by 50 percent. The reasons for the greater radiosensitivity of seed production than of vegetative growth are discussed. (auth)

8706 THE RADIOSENSITIVITY OF THALLI OF MARCHANTIA POLYMORPHA L. TO ACUTE GAMMA IRRADIATION. Miller, M. W.; Sparrow, A. H. (Brookhaven National Lab., Upton, N. Y.). Radiat. Bot., 5: 567-80(Dec. 1965). (BNL-9211).

Thalli of Marchantia polymorpha were irradiated with ^{60}Co gamma rays at exposures up to 55 kR and scored for survival after 4 weeks of growth. The reproductive integrity of the two apical cells of the thalli was inhibited by exposures lower than those required for complete lethality of the thalli. The nuclei of these apical cells are approximately 9.4 times larger than those in the vegetative cells adjacent to the proximal end of the rhizoids. At the 100 percent lethal exposure the energy absorbed by the interphase chromosomes of the vegetative cells of the thallus is within the 95 percent confidence limits as previously predicted for chromosomes of similar size in higher plants. The radiosensitivity of the thallus, however, is different from that of the gamma when sensitivity is based on an energy absorption basis: the thallus is approximately 4.3 times more sensitive than the gamma. (auth)

8707 CHROMOSOMAL ABERRATIONS IN IRRADIATED BLOOD AND BLOOD CULTURES OF NORMAL SUBJECTS AND OF SELECTED PATIENTS WITH CHROMOSOMAL ABNORMALITY. Dekaban, Anatole S.; Thron, Rosemarie; Steusing, Jan K. (National Inst. of Health, Bethesda, Md.). Radiat. Res., 27: 50-63(Jan. 1966).

Experiments were performed to determine whether the rates of chromosome or chromatid-type aberrations after irradiation in vitro are different in patients with chromosomal abnormalities from rates in normal people. Freshly drawn blood and blood cultures were irradiated with a total x-ray dose of 100 rads. The blood was taken from eight subjects; three of these were normal controls, and the remainder were patients with various chromosomal abnormalities. It was found that the rate of chromosome-type aberrations induced by irradiation of blood was significantly higher in a woman previously exposed to irradiation and whose control blood cultures had about 20% spontaneous breaks. This was less striking in a mongoloid patient with fewer chromosomal aberrations in the control blood cultures. In the remainder of the mongoloids and in one patient with treated leukemia the rates of chromosome-type aberrations in the irradiated blood were not significantly different from those in the normal controls. The rates of chromatid-type aberrations induced by irradiation of blood cultures 4 hrs prior to harvesting (G2) were not significantly different in the patients tested as compared to the normal controls. The relation of the number of acentric fragments to multicentric chromosomes in the first cell division was investigated. (H.G.D.)

8708 THE EFFECT OF X-RAYS ON THE ACTIVITY OF NEURONS IN THE RAT OLFACTORY BULB. Cooper, G. P.; Kimeldorf, D. J. (Naval Radiological Defense Lab., San Francisco). Radiat. Res., 27: 75-86(Jan. 1966).

Extracellular microelectrode recordings were made from single neutrons of the olfactory bulb in anesthetized rats. Approximately 15% of the units examined responded (usually by an increase in frequency) to 250-kvp x irradiation at dose rates of 1.5 to 2.0 R/sec when exposures of the whole animal, head only, or olfactory bulb region were made. No responses to irradiation were observed when exposures were made of the body only, the head posterior to the olfactory bulb, or the anterior 5 to 8 mm of the head. Ethyl alcohol perfused through the nasal cavities of tracheotomized rats abolished all responses to radiation. After perfusion of normal saline through the nasal cavities, responses of units to irradiation were readily obtained. In units studied both before and after perfusion of saline through the nasal cavities, the response was usually abolished temporarily. It was concluded that x-irradiation can in some way stimulate olfactory receptors. (auth)

8709 CELL PROLIFERATION UNDER CONTINUOUS IRRADIATION. Lamerton, L. F. (Inst. of Cancer Research, Surrey, Eng.). Radiat. Res., 27: 119-38(Jan. 1966).

The part that continuous irradiation can play in the study of the mechanisms of cell populations is reviewed. Topics discussed include: accumulation of damage under continuous exposure; the epithelium of the small intestine; and the red cell system. (H.G.D.)

8710 THE RBE OF FAST NEUTRONS FOR THE INACTIVATION OF BONE-MARROW COLONY-FORMING CELLS. Silini, G. (CNEN, Rome); Maruyama, Y.; Pozzi, L. Radiol. Med., 51: 515-23(May 1965). (In Italian).

Colony-forming cells from the bone marrow of hybrid mice were irradiated with 240 kv x-rays or 6 Mev fast neutrons and tested for the loss of reproductive activity according to the technique of growth in spleen. The RBE of the fast neutron beam compared with the standard x rays used was found to be 2.49. (tr-auth)

8711 IONIZING RADIATION AND HEALTH. Merenfeld, Ruben (Hospital Vargas, Caracas). Radiol. Med. Nucl. (Caracas), 1-4: 69-82(July 1961-June 1964). (In Spanish).

Sources of natural and artificial radiation and their effects on humans are reviewed. Relative biological efficiency of various types of radiations (α, β, γ rays, neutrons, and charged particles) is considered. Doses to which humans are exposed from different sources are listed and the relative importance of these for pathologic and genetic effects assessed. Medical sources of irradiation in diagnostic and therapeutic practices are considered in comparison to natural and fallout radioactivity doses to which humans are exposed. Particular attention is given to the genetic effect of cosmic and terrestrial radiations to which man has always been exposed during the course of his evolution, and of recently introduced sources of ambient radioactivity, especially that from nuclear weapons testing. The possible detrimental genetic effects, as applied to populations compared with individuals, is emphasized. (BBB)

8712 DOSIMETRY OF HIGH-ENERGY RADIATIONS. Breitling, G. (Univ., Tuebingen, Ger.). Radiologe, 4: 275-8(Aug. 1964). (In German).

Because of the greater biological effectiveness of the heavier radiation particles and neutrons it is necessary to separate their effects from those of x and γ rays and electrons. For neutrons this can be done by use of differential ionization chambers, or in weak irradiation fields by a pulse chamber or by proportional counting. For heavy radiation particles the energy dose is a function of the number of particles and their deceleration properties. For thermal neutron energies up to 100 Mev the maximum energy dose, measured in terms of rad/neutron/cm^2, increases from about 10^{-10} to 10^{-8}. Over this same range of energies the relative biological effectivity is somewhat higher, and increases from about 10^{-9} to almost 10^{-7} rem/neutron/cm^2. The energy dose from a broad beam is slightly greater than from a narrow beam. For fast electrons the energy dose in water, soft tissues, fat, and large bones varies with the tissue and the energy. Over the range from 1 to 50 Mev it decreases from 0.98 to 0.82 rad/R for soft tissues, from 1.04 to 1.0 rad/R for fat, but for bones it increases from 0.94 to 1.15 rad/R. For ultrahard x irradiation over the range from 3 to 50 Mv energy the dose factor decreases from 0.98 to 0.89 rad/R for soft tissues, from 1.04 to 1.02 rad/R for fat, but it increases from 0.93 to 1.11 rad/R for bone. (BBB)

8713 RESORPTION STUDIES AFTER X-IRRADIATION OF THE ABDOMEN FOR MALIGNANT LYMPHOGRANULOMATOSIS BY USE OF THE D-XYLOSE RESORPTION TEST AND THE ^{131}I-TRIOLEIN TEST. Sickinger, K.; Musshoff, K.; Stephan, F.; Appels, A. (Univ., Freiburg, i. B.). Strahlentherapie, 128: 340-6(Nov. 1965). (In German).

Twelve cases of malignant lymphogranulomatosis and one case each of seminoma and rectal carcinoma were investigated with the D-xylose-absorption test prior to and after abdominal irradiation. There was a disturbance in D-xylose absorption immediately after irradiation in 5 out of 14 cases. In 2 out of 2 cases examined 1 to 3 months after irradiation, a pathologically decreased excretion was observed. The ^{131}I-triolein-test was done immediately after irradiation in 7 cases; 2 out of the 7 cases showed a pathologically increased excretion. All of the cases that showed a pathological absorption test but had no clinical symptoms of an absorption disturbance received para-aortically a local x-ray dose of 3000 R or higher (200 kV, 1.0 mm Cu-filter). All 3 patients, who received telecobalt irradiation with local doses above 3000 R, showed no disturbances in absorption. A long-range prognosis course of the absorption disturbance is difficult, because of the progressive course of the diseases. (auth)

8714 AVOIDANCE OF A COMBINATION EFFECT IN THE COMBINED SURGICAL-RADIOLOGICAL TREATMENT OF MALIGNANT SKIN TUMORS. Stein, Guenter (Univ., Bonn). Strahlentherapie, 128: 347-50(Nov. 1965). (In German).

When the excision is done with the electro-coagulation method, the combined surgical-radiological treatment of the malignant melanoma results in a combined effect which requires months or years of conservative therapy to be cured. The injury produced by ionizing radiation heals within a few weeks if the excision was made with a scapel. (auth)

8715 TUMOR FREQUENCY AND LIFE SHORTENING AFTER FRACTIONATED X-RAY TOTAL IRRADIATION OF WHITE RATS. Reincke, Ursula; Stutz, Ernst; Hunstein, Werner (Univ., Freiburg i. B. Univ., Goettingen, Ger.). Strahlentherapie, 128: 425-40(Nov. 1965). (In German).

Wistar rats were given 900 R whole-body doses of x rays in either 3 fractions of 300 R each or 90 fractions of 10 R each. Basal cell tumors of the skin and sarcomas of the connective tissue were significantly increased in animals that were given the 300 R fractions. Median lifespans were 20 months for the 300 R group and 25 months for the 90 R group. In fact, all radiation effects were greater in animals receiving the 300 R fractions. It was concluded that there is no complete summation of the single doses. Recovery processes were more effective after the small daily exposures. (H.G.D.)

8716 IMMUNOLOGICAL PARALYSIS IN MICE EXPOSED TO SUBLETHAL IRRADIATION OR TREATED WITH 6-MERCAPTOPURINE. Brooke, Marcus S. (Massachusetts Inst. of Tech., Cambridge). Transplantation, 4: 1-7(Jan. 1966).

The amount of type III pneumococcal polysaccharide required to cause immunological paralysis in sublethally irradiated mice or in mice treated with 6-mercaptopurine was less than that required to produce paralysis in untreated animals. In irradiated mice the paralysis persisted for the duration of the experiment, but after cessation of the 6-mercaptopurine treatment unresponsive

animals, without further antigenic stimulation, made antibodies. Small doses of polysaccharide were antigenic when given 24 hours after irradiation. (auth)

8717 LYMPHOID REPOPULATION BY DONOR CELLS IN THE GRAFT-VERSUS-HOST REACTION. Fox, Miles (General Infirmary, Leeds, Eng.). Transplantation, 4: 11-21(Jan. 1966).

A graft-versus-host reaction was produced in (A × CBA) F_1 adult recipients following intravenous injection of 100 million CBA spleen cells. Subsequently a stronger response was evoked by presensitizing the donor animals, with or without sublethal irradiation of the hosts. The fate of the donor cells was studied by the T6 chromosome marker technique. Initial donor cell division in the spleen was observed in all the groups. It declined rapidly, except in irradiated recipients in which it continued till only donor mitoses were seen in the spleen and bone marrow from the 12th day to the end of the investigation on the 60th day, and subsequently on the 180th day. Signs of graft-versus-host disease when they occurred (usually in the 2nd and 3rd week) were associated with severe lymphoid depletion. In most cases rapid lymphoid diversion quickly replenished host lymphoid tissues and returned the animals to apparently normal health. In the present strain combination it did not appear to matter whether the repopulating lymphoid cells were host or donor in origin providing the animal was not left depleted. Evidence was obtained that the transplanted donor cells became tolerant of host antigens. (auth)

8718 FETAL LIVER AND THYMUS: ROLES IN THE ONTOGENESIS OF THE MOUSE IMMUNE SYSTEM. Tyan, M. L.; Cole, L. J.; Nowell, P. C. (Naval Radiological Defense Lab., San Francisco. Univ. of Pennsylvania, Philadelphia). Transplantation, 4: 79-83(Jan. 1966).

Liver cells or thymic grafts from homozygous embryonic mice were subjected to passage through appropriate nonoperated or thymectomized adult F_1 hybrids. Passage through a nonthymectomized host was required for maturation of potential immunologically competent cells derived from embryonic liver; this was not true with regard to cells derived from a fetal thymic graft. Cells from embryonic liver were found first in the host thymus while those from thymic grafts appeared to migrate exclusively to peripheral lymphoid tissues. (auth)

8719 LOCAL IRRADIATION OF RABBIT SKIN ALLOGRAFTS. McCormick, John R.; Egdahl, Richard H. (Boston Univ.). Transplantation, 4: 100(Jan. 1966).

Survival of skin grafts was studied in rabbits treated with x rays, 6-mercaptopurine, or a combination of the two. Local irradiation neither affected rejection time of rabbit skin allografts nor prolonged allograft survival in animals treated with 6-mercaptopurine. (H.G.D.)

8720 CHROMOSOME BREAKAGE AND REUNION: ACTION OF AZASERINE AND X RAYS. Davidson, D. (Western Reserve Univ., Cleveland). Z. Vererbungsl., 96: 217-27(1965).

Bean (Vicia faba) roots were immersed for 1, 3, and 24 hr in 0.1, 0.01, and 0.001 mM solutions of azaserine, a radiomimetic compound. They were then washed, returned to distilled water, and fixed up to 120 hr from the end of treatment. Roots were treated with colchicine before fixation to arrest mitosis at metaphase. Other roots were treated with azaserine and also irradiated. The x-ray dose of 100 or 200 R was delivered at 200 R/min. Following treatment with azaserine and x rays, chromosome breakage and reunion, which produced dicentric and ring chromosomes, was found. It did not occur, however, in cells with aberrations induced by azaserine. Azaserine, and perhaps other radiomimetic chemicals, does not act on the chromosome before the period of synthesis and splitting. The evidence from combined treatments is that azaserine acts during the postsynthetic period of interphase. Aberrations induced by azaserine probably result from an effect on some normal process. Apparently it does not induce breaks, physical discontinuities, but does not prevent normal restitution. (BBB)

8721 FACTORS CONCERNING POST-IRRADIATION BACTEREMIA IN MICE [Thesis]. Ulrich, Marian Irene. Stanford, Calif., Stanford Univ. 1965 121p.

The possible role of a depletion of naturally occurring antibody in the pathogenesis of post-irradiation bacteremia in mice was studied. In addition, the influence of the presence or absence of hemolytic complement on the incidence of infection following irradiation and on the types of organisms isolated was studied. Finally, preliminary experiments were done to investigate the possible protective role of normal leukocytes in experimental infection with Salmonella enteritidis following irradiation. CF-1 mice were used throughout this study; mortality following exposure to 550 roentgens of x irradiation varied from 60 to 90 percent in 30 days, and bacteremia accompanied about 50 percent of the deaths. It was concluded that the production of agglutinins and bactericidins specific for representative organisms from several genera associated with post-irradiation bacteremia was not interrupted following exposure to midlethal x irradiation. This conclusion is consistent with the observation that the concentration of gamma globulin in mouse serum taken after irradiation was not reduced, but in fact increased. The availability of mice with and without hemolytic complement provided an opportunity to investigate the possible role of this factor in resistance to infection. No significant differences in the occurrence of either mortality or bacteremia were observed when equal numbers of each type of mice were irradiated. No association was found between the presence of hemolytic complement and serum-resistance of the organisms causing infection. Finally, the passive transfer of normal blood leukocytes or peritoneal cells was effective in prolonging survival in irradiated mice following deliberate challenge with an avirulent strain of Salmonella enteritidis. No support was found for the hypothesis that depletion of naturally-occurring antibody might play a role in the pathogenesis of post-irradiation bacteremia in mice. (A.G.W.)

Radiation Effects Therapy and Countermeasures

Refer also to abstracts 8529 and 8585.

8722 (CONF-727, pp 39-46) URINARY ELIMINATION FOLLOWING INHALATION OF INSOLUBLE PLUTONIUM OXIDE. Sheehan, W. E. (Mound Lab., Miamisburg, Ohio).

From two inhalation exposure cases of plutonium oxide, the urinalysis data indicate that DTPA treatments are the most effective from 100 to 300 days after exposure. (auth)

8723 (TID-22503) THE APPLICATION OF CLONED HAEMOPOIETIC CELLS IN RADIATION PROTECTION. Progress Report No. 4, 1964-65. Feldman, Michael (Weizmann Inst. of Science, Rehovoth (Israel)). Contract AT(30-1)-3173. 6p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Experiments were carried out to test the effects of transfusion-induced polycythemia on the formation and differentiation of cell-specific clones. Polycythemic and uninjected, x-irradiated mice were inoculated with 1, 2, or 5×10^4 bone marrow cells from syngeneic donors. The polycythemic animals showed a 3-fold decrease in the total number of macroscopic nodules as compared to normal x-irradiated recipients. The polycythemic animals showed a complete suppression of erythroid clones. It was concluded that polycythemia appears to specifically suppress the formation of erythroid clones. It was also found that oxygen is a necessary, although it may not be a sufficient, factor in preventing erythroid clone formation. (P.C.H.)

8724 (UCRL-16545) RECOVERY OF YEAST AFTER EXPOSURE TO DENSELY IONIZING RADIATION. Lyman, J. T.; Haynes, R. H. (Lawrence Radiation Lab., Univ. of California, Berkeley). Sept. 1965. Contract W-7405-eng-

48. 21p. (CONF-650924-7). Dep. mn. CFSTI $2.00 cy, $0.50 mn.

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A great enhancement of viability was observed if nonnutritive suspensions of diploid yeast, which were irradiated with x rays or heavy ions (^{4}He, ^{12}C, ^{20}Ne), were stored at 30°C in the dark for 4 or more hours prior to plating. Maximum recovery was usually observed after 24 to 48 hours; the survival curves obtained upon delayed plating were related to those for immediate plating by a constant dose-modifying factor. Several lines of evidence indicate that recovery is based upon enzymic postirradiation processes unrelated to the initial physiochemical reactions associated with absorption of the radiation. The recovery appears to be substantially independent of the precise chemical nature of the radioinduced lesions. Very severe macromolecular damage is likely to be produced by the densely ionizing radiations. The ability of diploid yeast to recover after such irradiation suggests that a bypass rather than a direct repair mechanism may be involved. (P.C.H.)

8725 APROPOS OF CHEMICAL RADIOPROTECTION (AGREEMENTS AND DISAGREEMENTS OF DIFFERENT TESTS). Lozeron, H.; Maggiora, A. (Hopital Cantonal, Geneva). Dermatologica, 131: 28-40(1965).

Comparative tests were made with numerous radioprotective agents on their ability to prevent x-ray induced lethality in mice, epilation of guinea pig skin, and inhibition of growth of Vicia faba roots. In the transitory epilation test with guinea pigs and mortality test with mice, of 14 substances which were examined, 6 protected in both tests, namely 5-hydroxytryptamine (5-HT), cysteamine, cysteine, 5-hydroxytryptophan (5-HTP), tryptophan, and acetylcholine. In mouse mortality tests and root growth tests of V. faba, of the 11 compounds tested, 6 were protective in both tests (5-HT, cysteamine, cysteine, acetylcholine, pentylenetetrazol, and Na succinate). Of the 9 substances assayed in a comparison of guinea pig epilation and root elongation, 5 protected in both instances (5-HT, cysteamine, cysteine, acetylcholine, and ascorbic acid). Thus four compounds were effective in all three tests: 5-HT, cysteamine, cysteine, and acetylcholine. In general, it is concluded, the results with the three tests were in agreement. Most nonprotective substances assayed were ineffective in all three tests. One exception in particular was hydrocortisone disuccinate which failed to protect the mouse or guinea pig but was effective in the bean root tests. (BBB)

8726 ANTIOXIDANT ACTIVITY OF MOUSE LIVER LIPIDS IN RADIATION SICKNESS AND LEUKOSIS AND THE EFFECT OF FREE RADICAL REACTION INHIBITORS. Burlakova, E. B.; Dzyuba, N. M.; Pal'mina, N. P.; Emanuel', N. M. Dokl. Akad. Nauk SSSR, 163: 1278-81 (Aug. 11, 1965). (In Russian).

The antioxidant activity changes of liver lipids were studied after single or repeated administration of free radical reaction inhibitors to intact animals. Mice were injected intraperitoneally with the inhibitors dissolved in water or a 10% Tween-80 solution. The natural antioxidants were extracted from the lipid fraction of the animal livers and dissolved in methyloleate, which was then oxidized in an air current at 36°C in an oxidizing chamber. The kinetics of antioxidant activity changes of lipid extracts following single introduction of 4-methyl-2,6-di-tert-butylphenol is graphed. It was observed that a single administration increased the antioxidant activity while repeated administrations depressed this activity for some time depending on dose. It may be thus assumed that synthetic inhibitors resemble natural ones. Repeating this experiment with mice which had received a lethal radiation dose and whose antioxidant activity had declined to zero, it was found that with a 30 mg/kg dose of the above compound the activity level was maintained and 20 to 25% of the mice survived, while a 100 mg/kg dose had no such effect. Since cancer cells are known to differ from normal cells by the amount of antioxidants, tests were conducted in mice with leukemia who received the inhibitor 4-oxy-3,5-di-tert-butyl-alpha-methylbenzamine, which depressed and lengthened the initial activity of liver lipids. In animals irradiated prior to the development of leukemia, the activity developed at a slower pace the higher the dose, resulting in increased survival times of up to 2 days. Similar results were obtained for animals whose antioxidant activity was depressed by administering large amounts of the inhibitor. It may thus be concluded that small amounts of inhibitor, which cannot decrease the antioxidant activity of liver lipids in the intact animal, display a radioprotective effect and favor the development of transplanted cancer, while large amounts which can decrease this activity will aggravate radiation sickness, but slow down the development of leukemia. (CFSTI)

8727 QUANTITATIVE ASPECTS OF THE STORAGE OF BONE MARROW CELLS FOR TRANSPLANTATION. Van Putten, L. M. (Radiobiological Inst. TNO, Netherlands). Europ. J. Cancer, 1: 15-22(June 1965).

Quantitative studies are presented of the effect of different storage techniques on mouse and monkey bone marrow cell suspensions. The ability to produce 30-day survival in lethally irradiated hosts was used as an endpoint. Results indicated that: optimal protection of mouse bone marrow cell suspensions was found after addition of 10% PVP (polyvinylpyrrolidone) and with the combinations 10% PVP, 10% glycerol and 10% PVP, 10% DMSO (dimethylsulphoxide). For isologous mouse bone marrow optimal storage efficiency approximates 100%, for fetal mouse liver cells 40%; and for autologous monkey bone marrow storage methods based on the addition of glycerol or DMSO were found to be ineffective. Poor protection was afforded by addition of 10% PVP alone or by a 10% PVP, 10% DMSO mixture. Optimal preservation during storage (up to 50% effectiveness) was found for monkey bone marrow with a 10% glycerol, 10% PVP mixture. It is concluded that although species differences in storage effectiveness preclude dependable recommendations for storage of human bone marrow, a careful trial of the glycerol–PVP combination in man seems indicated. (auth)

8728 POTENTIAL ANTIRADIATION AGENTS. PREPARATION AND POLYMERIZATION OF MONOMERIC THIAZOLIDINES. Overberger, C. G.; Ringsdorf, H.; Avchen, B. (Polytechnic Inst. of Brooklyn, N. Y.). J. Med. Chem., 8: 862-4(Nov. 1965).

Present radioprotective agents offer relatively short-lived protection; therefore, studies were undertaken to prepare compounds that may act as sources of molecular entities of proven protective capacity. Compounds were so designed that they would slowly release moieties such as 2-mercaptoethylamine and cysteine under physiological conditions, and in so doing provide a long-lasting source of radioprotective agent in nontoxic amounts. Since the thiazolidine heterocycle is readily cleaved to α-amino-β-thiols under mild hydrolytic conditions, the preparation of polymeric thiazolidines of 2-mercaptoethylamine and cysteine was carried out by a synthetic method which is outlined. (TCO)

8729 THE EARLY EFFECT OF IONIZING RADIATION ON LARGE ANIMALS. Brown, Daniel G. (Univ. of Tennessee, Oak Ridge). MSU (Mich. State Univ.) Vet., 24: 127-33(Spring 1964).

Responses of cattle, swine, sheep, and burros to large doses of radiation are described, and the $LD_{50/30}$ values for various domestic animals are tabulated. The acute radiation syndrome of each species is compared to that of the others. (H.G.D.)

8730 BONE MARROW ALLOGRAFTS IN THYMECTOMIZED X-IRRADIATED DOGS. Chertkov, I. L.; Maximenko, A. S.; Novikova, M. N.; Raushenbach, M. O. (Inst. of Haematology and Blood Transfusion, Moscow). Nature, 208: 399-400(Oct. 23, 1965).

Experiments were performed on adult thymectomized dogs to determine whether the transformation of transplanted hemopoietic cells into lymphocytes requires a

thymic factor. One to two months after thymectomy the dogs were x irradiated with 1000 R. On the following day the dogs were injected with viable nucleated bone marrow. Thymectomy as such did not influence the hematologic picture, particularly lymphopenia. The degree of radiation sickness was very heavy and several died before any repopulation of the bone marrow graft appeared. In the surviving animals no significant transformation of hemopoietic cells into lymphocytes was observed. It is concluded that for large animals, including man, the thymus is necessary for functional differentiation of polypotent stem cells into lymphoid precursors. (H.G.D.)

8731 MODIFICATION OF RADIATION-CEREBRAL DEATH BY HYPOXIA. Wright, E. A.; Shewell, Jennifer (St. Mary's Hospital Medical School, London). Nature, 208: 904-5(Nov. 27, 1965).

Protection from radiation damage by induction of brief periods of hypoxia at the time of irradiation was studied in Swiss mice irradiated head-on by 8-Mev electrons from a linear accelerator. Control mice were irradiated in air. Experimental groups were given: pure nitrogen to breathe prior to and during irradiation; oxygen at one atmosphere to breathe for at least a minute before and during irradiation; cysteamine injections 15 min before irradiation in air. Nitrogen breathing produced a marked change in radiosensitivity to massive doses of radiation. Cysteamine failed to exert a significantly protective effect probably because uptake by the mouse brain 15 min after injection reached only $1/5$ the amount taken up by kidneys, liver, and intestine. Breathing oxygen at 1 atmosphere had a slight protective effect. (H.G.D.)

8732 EFFECT OF SOME METABOLITES AND ANTIMETABOLITES ON THE BREAKDOWN OF DEOXYRIBONUCLEIC ACID AND ON THE COLONY-FORMING ABILITY OF ESCHERICHIA COLI B AFTER GAMMA IRRADIATION. III. EFFECT OF UNCOUPLING AGENTS AND THE FATE OF RIBONUCLEIC ACID AND PROTEIN DURING THE BREAKDOWN OF DEOXYRIBONUCLEIC ACID AND ITS INHIBITION. Drakulic, M.; Kos, E. (Inst. Ruder Boskovic, Zagreb). Radiat. Res., 27: 2-9(Jan. 1966).

The effect of the uncoupling agents 2,4-dinitrophenol, sodium azide, and salicylate on the γ-induced breakdown of DNA and lethality in E. coli B, incubated after irradiation in acetate buffer was studied. These agents caused nearly a complete inhibition of γ-induced DNA breakdown in E. coli B, and suppressed also the biosynthesis of the macromolecule in the control. They had no effect on the viability of the unirradiated cells, and there was not a great change in the survival of irradiated cells, as compared with the results obtained in acetate buffer alone. A breakdown of RNA was observed in the irradiated starving bacteria that was a different kinetics and smaller than the breakdown of DNA. RNA breakdown was also inhibited by some of the agents that inhibited DNA breakdown. The protein content of the irradiated starving bacteria did not change during incubation after irradiation. (auth)

8733 THE EFFECT OF DEPOLYMERIZED DEOXYRIBONUCLEIC ACID AND DEOXYRIBONUCLEOTIDES ON THE SURVIVAL OF X-IRRADIATED MAMMALIAN CELLS IN CULTURE. Petrovic, Danilo; Miletic, Branimir; Ferle-Vidovic, Ana; Han, Antun (Inst. Ruder Boskovic, Zagreb). Radiat. Res., 27: 41-9(Jan. 1966).

Experiments were designed to establish a possible restorative effect of depolymerized DNA and deoxyribonucleotides. The ability of L-cells to form visible colonies after x-irradiation was used as the criterion of survival. Compounds to be tested were added to the growth medium immediately after the cells were irradiated with 500 R. The addition of enzymatically hydrolyzed DNA as well as of four deoxyribonucleotides displayed a restorative effect that did not differ from that obtained with highly polymerized isologous DNA. The addition of a single deoxyribonucleotide, however, did not produce any significant restorative effect irrespective of its concentration. The results suggest that the restoration of radiation damage in these cells could occur by influencing some metabolic pathways involved in the synthesis of nucleic acids. (auth)

8734 PROTECTION AGAINST GENETIC AND EMBRYOLOGICAL RADIATION DAMAGE. Leonard, A. (CEN, Mol, Belg.). Rev. Franc. Etud. Clin. Biol., 10: 792-8(Oct. 1965). (In French).

Since many people can now receive small or high doses of irradiation from their occupation or from medical treatments, the problem of radiation protection against genetic and embryological damage is more and more important. Some results showed that doses as small as 1 or 2 R are able to increase the mutation rate in man or to induce embryological damage in pregnant women. Some experiments showed that chemical compounds, chiefly the sulfhydryl and related compounds give some genetic as well as embryological protection. Cysteamine and AET given prior to irradiation, decrease the mutation rate induced in male germ cells, while cysteamine given to pregnant females before irradiation decrease the rate of malformation in newborn animals. (auth)

8735 INVESTIGATIONS ON THE ACTION MECHANISM OF THE RADIOPROTECTIVE SUBSTANCE METHANDROSTENOLONE. PART I. INFLUENCE OF METHANDROSTENOLONE ON THE CHANGES IN PROTEIN AND NUCLEIC ACID LEVELS AFTER IRRADIATION. Danysz, Andrzej; Panek, Ryszard; Proniewski, Henryk; Kruszewska, Jadwiga (Medizinische Akademie Bialystok, Poland). Strahlentherapie, 128: 419-24(Nov. 1965). (In German).

The influence of methandrostenolone on total nitrogen and residual nitrogen levels in tissue, RNA and DNA level, total water content, dry substance of organs, body weights, and leukocyte number in the peripheral blood was investigated. It was found that methandrostenolone administered to rats (1 mg/kg) prior to and after irradiation decreased significantly, and in some cases normalized disturbances in total water content, dry substance of the organs, and the content of proteins and nucleic acids appear in rats after irradiation with 450 R. It is assumed that the radioprotective effect of methandrostenolone is based on its anticatabolic and anabolic mechanism. (auth)

8736 DAYTIME VARIATIONS IN THE RADIATION EFFECTS ON RATS. Fochem, Kurt; Michalica, Werner; Picha, Engelbert (Universitaets-Frauenklinik, Vienna). Strahlentherapie, 128: 441-4(Nov. 1965). (In German).

Results obtained with total body irradiation of rats at different times of the day are reported. A 50% higher survival rate was obtained for animals that were irradiated at 9:00 a.m. compared with the group that was irradiated at 9:00 p.m. Histological liver sections of animals that survived the LD_{50} after more than 2 months, showed considerable differences of the reparative events, in regard to the extent of the liver damage, in favor of the animals which were irradiated at 9:00 a.m. (auth)

8737 ON RADIATION PROTECTION FROM HISTORICAL REVIEW. A CONTRIBUTION TO THE HISTORY OF MEDICINE. Schneider, Georg Heinrich Strahlentherapie, 128: 460-77(Nov. 1965). (In German).

Review articles on radiation protection are discussed, and radiation protection is considered from a historical point of view. (H.G.D.)

8738 TREATMENT OF EXPERIMENTAL RADIATION ILLNESS WITH BONE MARROW AND ANTIBIOTICS. Alexandrov, S. N.; Galkovskaya, K. F.; Baidachenko-Rostovtseva, T. I. (Central Research Inst. for Roentgenology and Radiology, Ministry of Public Health, USSR). Vop. Onkol., 11: 77-81(1965). (In Russian).

The effects of bone marrow transplants on the outcome of radiation sickness induced in mice by whole-body from ^{60}Co γ-rays at doses of 600, 900, 1100, or 1200 R was studied. The intravenous infusion of marrow cells was carried out immediately after irradiation. The low mortality of mice irradiated with 600 R (3%) did not show the

therapeutic effect of the marrow transplant. This was best seen at 900 R dose. We succeeded in expanding the therapeutic effect of the marrow autotransplantation up to the dose of 1200 R when combining it with the infusion of streptomycin. The addition of tetracycline to this complex exerted an unfavorable influence on the animals irradiated at the dose of 1200 R. Bone marrow transplants were effective in doses up to 1200 R when combined with infusions. Tetracycline, however, produced an unfavorable response. (H.G.D.)

8739 KOMPLEKSNOE LECHENIE OSTROI LUCHEVOI BALEZNI. (Complex Therapy of an Acute Radiation Sickness). Chebotarev, E. E. Kiev, Naukova Dumka, 1965. 268p.

A review is given of experimental data on the therapeutic properties of a protein blood plasma substitute (BK-8) certain blood producing stimulators (batyl alcohol and vitamin B_{12}) and antibiotics (penicillin, streptomycin, bicillin-3). Radioprotective properties of derivatives of monothiocarbonic acid are also discussed. Extensive references are included. (R.V.J.)

Radiation Hazards and Protection

See also HEALTH AND SAFETY

8740 (CONF-727, pp 136-41) PRELIMINARY RESULTS ON THE URANIUM CONTENT IN THE HUMAN DIET. Welford, George A.; Baird, Ruth (Health and Safety Lab., New York Operations Office (AEC), N. Y.).

Uranium levels in the human diet were determined in samples from New York City, Chicago, and San Francisco. A known aliquot of ^{232}U as tracer was added to samples of dry ashed food material. Organic material was destroyed by multiple evaporations with HNO_3 and H_2O_2. The resulting salts in 7N HCl solutions were passed through an ion exchange column of pretreated Dowex. After washing with 9N HCl and elution with 1N HCl, the elutriant was evaporated and the residue dissolved in H_2SO_4. Following iron removal, the solution was dried, dissolved with HNO_3, and fused with sodium fluoride. Overall recovery indicated by the tracer technique was above 80%. Uranium contents were measured in bakery products, whole grain products, and fresh vegetables. Measured in micrograms of uranium/gram of ash, higher uranium levels were found in fresh vegetables and whole grain products from San Francisco and in bakery products from New York City. (H.G.D.)

8741 (CONF-727, pp 142-51) MEASUREMENT OF ^{225}Ra AND ^{222}Rn IN ENVIRONMENTAL SAMPLES. Harley, Naomi A.; Harley, John H.; Fisenne, Isabel M. (Health and Safety Lab., New York Operations Office (AEC), N.Y.).

Procedures for determining ^{226}Ra in human bone ash and in vegetation or vegetation ash are described. Both techniques use ^{133}Ba tracers. Average radium recovery was determined in 12 samples of bone ash and in nine samples of hay ash and raw tobacco with added ^{226}Ra and corrected by ^{133}Ba yields. Recovery from bone ash of ^{226}Ra, ^{133}Ba, and ^{226}Ra corrected by ^{133}Ba was respectively: 94.4%, 94.8%, and 99.6%. In vegetation samples recoveries were: ^{226}Ra, 85.6%; ^{133}Ba, 86.1%; and ^{226}Ra corrected by ^{133}Ba, 99.5%. A system for radon determinations is presented. With the system 1000 liters of air containing a known radon concentration were run with 100% yield. (H.G.D.)

8742 (COO-119-233, pp 97-100) GAMMA-RAY EMITTERS IN CONCRETE. Lloyd, Ray D.; Folland, Gerald B.; Church, Bruce W.; Taysum, David H. (Utah Univ., Salt Lake City. Radiobiology Div.).

The content of radionuclides in samples of ready-mix concrete obtained from three local suppliers was determined by gamma-ray counting. Average concentration of gamma emitters in the concrete in pC per gram was found to be: ^{226}Ra 0.7; ^{228}Ra 0.6; ^{228}Th 0.6; and ^{40}K 7.9 (9 mg K). Retention of ^{222}Rn activity in the hardened concrete was about 85% that of the ^{226}Ra. The radioactivity of constituents was also measured. Concentration of gamma-ray emitters in gravel was approximately equal to that in the concrete mix, while their concentration was about 40% higher in sand and about 50% lower in cement. (auth)

8743 (LA-DC-6827) DESIGN AND OPERATIONAL RADIATION SAFETY CRITERIA FOR MANNED SPACE FLIGHT. Langham, Wright H. (Los Alamos Scientific Lab., Univ. of California, N. Mex.); Brooks, Phillips M. (McDonnell Aircraft Corp., St. Louis, Mo.); Grahn, Douglas (Argonne National Lab., Ill.). [1964]. Contract W-7405-eng-36. 262p. Dep. mn; CFSTI $6.00 cy, $1.25 mn.

A study to derive criteria for consideration of man's response to space radiation exposure so that radiation risks may be taken into account, during spacecraft design and operational planning phases, along with the other inherent hazards of manned space flight is presented. The only basis for derivation of such criteria is the vast amount of radiation data on animals and occasionally man. The space radiation environment is discussed in some detail. A review of known biological effects of ionizing radiation is presented. Applications of these results to space flight operations are discussed. (M.O.W.)

8744 REGULATIONS GOVERNING IONIZING RADIATIONS. BASIC PRINCIPLES, PRACTICAL PROCEDURES AND EURATOM'S PROGRAMME. Recht, P. (EURATOM, Brussels). Health Phys., 12: 65-75(Jan. 1966).

The general principles underlying a radioactive safeguards policy are dominated by the concept of prevention, which relates to both nuclear accidents and chronic exposure. The notion of calculated risk is discussed. The practical implementing measures as embodied in regulations are based on the definition of the field of activity, notification or authorization of such activities, the establishment of maximum levels, the organization of safeguards procedures by competent persons and the obligation to promote training and information with regard to the radioactive hazard. Euratom is particularly active in the field of regulations with respect to six European countries. A more explicit account of the general principles and the manner in which they are now implemented under the various European laws that have been enacted in line with the Basic Standards promulgated by Euratom in 1959 are presented. (TCO)

8745 SOME PROBLEMS IN THE APPLICATION OF ICRP MAXIMUM PERMISSIBLE LEVELS FOR OCCUPATIONAL EXPOSURE. Dunster, H. J. (United Kingdom Atomic Energy Authority, Harwell, Eng.). Health Phys., 12: 77-82(Jan. 1966).

The problems are discussed from the standpoint of the interpretation rather than the implementation of ICRP recommendations. It is suggested that it would be useful to consider the recommendations in two distinct groups. The first group would comprise recommendations dealing with fundamental matters directly affecting people, such as maximum permissible organ doses. These would be regarded as mandatory. The second group would contain the more general recommendations dealing with the workers' environment and with the organization of protective measures. These could be treated as general guides and interpreted with flexibility. Suggestions are made for changes in the fundamental recommendations that would simplify their practical use. Emphasis is placed on the need to depend more on the professional judgment of the health physicist and medical officer and less on a rigid form of recommendation which can be interpreted legalistically. (auth)

8746 EFFECT OF VARIOUS HORMONES, ISOTOPES, AND ISOTOPE-TAGGED HORMONES ON BREAST CANCER IN RATS. Fletcher, William S.; McSweeney, E. Douglas Jr.; Dunphy, J. Englebert (Univ. of Oregon Medical School, Portland). J. Am. Med. Assoc., 191: 116-18(Jan. 11, 1965).

Breast tumors sensitive to estrogen were induced in 50-day-old female Sprague-Dawley rats with one feeding of 20 mg of 7,12-dimethyl-benz(a)anthracene in sesame oil. At 60 days, when about 20% of the animals had developed

tumors, the rats were divided into six groups of 25 rats each. Seventy-three % of group 1 control animals developed tumors. Group 2 animals received diethylstilbestrol for 30 days. All existing tumors progressed rapidly during initial treatment, then diminished and finally disappeared. Group 3 animals received 10 μC sodium phosphate-^{32}P and all existing tumors progressed and all 25 rats developed tumors. Group 4 rats received 10 μC sodium phosphate-^{32}P in five divided doses during the 30-day treatment period. There was a steady increase in the number of tumors, paralleling the results in untreated controls and animals receiving ^{32}P in one dose. Group 5 rats received 10-μC diethylstilbestrol diphosphate labeled with ^{32}P in one dose. All existing tumors were extinguished within 30 days. Group 6 animals which received 10 μC diethylstilbestrol diphosphate labeled with ^{32}P in five divided doses also had diminution in the number and size of existing tumors. Thus all tumors treated with the hormone-isotope combination were extinguished and did not recur, whereas in control animals receiving sodium phosphate-^{32}P alone the rapid development and growth of tumors continued. Uptake of ^{32}P in tumors was doubled by its incorporation into the diethylstilbestrol molecule. At six hr the uptake of ^{32}P as the phosphate was 1×10^5 cpm/g wet weight tumor tissue. The uptake of ^{32}P as the diethylstilbestrol diphosphate was 2.1×10^5, a difference of more than 100%. It is unlikely that doubling the concentration of ^{32}P in the tumors could account for the marked difference in response between ^{32}P-treated animals and diethylstilbestrol labeled with ^{32}P treated animals. Several possible explanations for this are offered. First, the diethylstilbestrol may carry the ^{32}P to a highly vulnerable portion of the neoplastic cell, e.g., nucleic acids. Second, the action of the two agents may be synergistic with one potentiating the other. Third, the action of the diethylstilbestrol labeled with ^{32}P may not be on the tumor at all but rather mediated through the neuroendocrine system. (BBB)

8747 IMAGE-INTENSIFYING DEVICES AND MODERN RADIATION PROTECTION. Barany, Janos (Veszprem Megyei Korhaz, Hung.). Orv. Hetilap, 105: 1815-16 (Sept. 20, 1964). (In Hungarian).

Use of amplifying equipment to reduce patient and personnel exposure during fluoroscopy is briefly discussed. (BBB)

8748 ON THE PROCEDURE FOR RADIATION PROTECTION IN APPLICATION OF STRONTIUM-90 IN DERMATOLOGY. Koerner, H. -J. (Mess- und Pruefstelle fuer die Gewerbeaufsichtsverwaltung des Landes Hessen, Kassel, Ger.). Zentr. Arbeitsmed. Arbeitschultz, 14: 137-40(June 1964). (In German).

In dermotherapeutic use of enclosed ^{90}Sr irradiation sources of up to 20-mC activity, an annual test of intensity and structure is not required. The test interval can be extended to three yr. If there is any visible evidence of damage or change in the structure of the shield, the source should not be used, and should be returned to the manufacturer for testing. In all cases where the number of irradiation sessions does not exceed 100/yr, measurement of personal dose received is not necessary. However, the user should be prepared at all times to have appropriate records of irradiation treatments available for inspection. These records should include specifically the number and duration of irradiation sessions and other happenings. These requirements which are in accord with current regulations represent a simplification of procedures. They will require revision of another source of irradiation, such as an x-ray source. Procedures for measurement of irradiation from ^{90}Sr sources are described, and the results of dosimetric studies of various configurations of encapsulated sources are compiled. (BBB)

Radiotherapy and Radiodiagnosis

Refer also to abstract 9283.

8749 (STI/PUB/6(Vol.1)) ATLAS OF RADIATION DOSE DISTRIBUTIONS. VOL. I. SINGLE-FIELD ISODOSE CHARTS. Webster, E. W.; Tsien, K. C. (International Atomic Energy Agency, Vienna (Austria)). July 1965. 155p. IAEA $15.00.

The basic information used for planning therapeutic treatments with gamma, x-ray, and electron beams is contained in charts presenting the distribution of dose in planes through tissue-equivalent absorbers. The single field atlas comprises 155 isodose charts selected from 48 institutions in 11 different countries. The majority of the charts are for cobalt-60 and cesium-137 teletherapy units. These range from short-distance units containing dekaCuries to units operating at one meter with several kC. Charts for 18 different cobalt-60 units and 13 different cesium-137 units are included. High-energy x-ray machines ranging from 2 to 70 Mv are also represented, with 15 charts from five different linear accelerators, 16 charts from four different betatrons, and charts for three other supervoltage units. Another section of the Atlas comprising 25 charts is devoted to electron beams ranging in energy from 7 to 35 Mev. The electron sources are three betatrons and two linear accelerators. The purpose of the Atlas is to illustrate the effects of physical factors on the distribution of dose within a unit-density homogeneous medium irradiated with single beams of radiation. The physical factors include beam energy, irradiation distance, field size, source size, collimator design, and angle of inclination of the beam. Some charts are included to illustrate the effects on the isodose patterns of wedge filters and of absorbers which modify field shape. The charts are presented full-size so that they may be readily intercompared and will be useful in basic exercises on treatment planning. In teaching the principles of radiotherapy and radiological physics, this diverse and comprehensive collection of charts should be a unique asset for demonstrating the importance of physical variables. (P.C.H.)

8750 CYTOLOGY IN THE RADIOTHERAPY OF CARCINOMA OF THE ORAL CAVITY. Umiker, William (Univ. of Michigan Medical Center, Ann Arbor). Acta Cytol., 9: 296-7(July-Sept. 1965).

Oral smears were obtained from 50 patients prior to, during (at least three times per week), and following standard external x-ray therapy for oral cancer, in attempts to detect a radiation sensitization response. The pretreatment smears were of limited value except for establishing baselines from which to measure subsequent cytologic alterations in individual cases. The so-called S-R cells reported by Graham in vaginal smears from women whose cervical cancers responded favorably to radiotherapy were not encountered in oral smears. However, changes in the benign irradiated cells were very similar to those in vaginal smears. Cell enlargement, increase in nuclear size, cytoplasmic vacuolization, and multinucleation were seen and evaluated quantitatively. Cell enlargement was the most frequent and striking change. Cytoplasmic vacuolization was not observed as often as it is in vaginal smears. Alterations became distinct by the end of the first week of treatment and usually reached a peak by the end of the second week. Clinical manifestations of radiation, such as mucositis or membrane formation, were observed between the time of onset of cytologic changes and the point of max development of these alterations. Although there was some statistical correlation between the degree of benign cell response and the clinical results, this was not sufficiently consistent to make valid individual prognostications. In fact, there was better correlation between clinical results and the size of the cancer. The only changes which correlated with the clinical results were those involving nuclei of the malignant cells. Such nuclei were classified as: Type A, Type B, and Type I. Type A nuclei were smaller than Type B nuclei and had dense, abundant chromatin which obscured the nucleoli. When studied by acridine-orange fluorescence microscopy, these

nuclei presented brilliant yellow fluorescence, indicating high DNA content. An increase in the percentage of Type B nuclei of malignant cells during treatment was the most promising prognostic indicator in the radiotherapy of oral cancer. (BBB)

8751 DOSIMETRY OF THE SMALL RADIOACTIVE SOURCES EMPLOYED FOR THE FUNCTIONAL DESTRUCTION OF THE HYPOPHYSIS. Dutreix, J. (Institut Gustave Roussy, Villejuif, France). Acta Isotop., 4: 309-25(1964). (In French).

Radioinduced pituitary ablation is discussed. Interstitial irradiation with pure β sources such as ^{32}P and ^{90}Y is considered preferable to the use of mixed β-γ sources such as Rn and ^{198}Au because of the greater activity of the latter in large body areas. A method for determining β dose directly in the body is presented. The method is based on using two sources of ^{90}Y and ^{32}P. Dosimetry is determined by dividing the sources into two lateral groups centered in the ideal position. (H.G.D.)

8752 THE USE OF HEAVY PARTICLES AND THE BRAGG PEAK IN THERAPY. Lawrence, J. H. (Univ. of California, Berkeley). Acta Isotop., 4: 327-45(1964).

The advantages of using high-energy, heavy-particle beams in radiotherapy are discussed. Successful applications of heavy particles in radiotherapy include: ablation or suppression of pituitary function in the treatment of patients with metastatic breast cancer, acromegaly, diabetic retinopathy, Cushing's disease, and malignant exophthalmos; direct treatment of soft tissues and brain tumors; and thalamotomy in the treatment of patients with Parkinson's disease. (H.G.D.)

8753 RESULT FROM TREATMENT OF CUSHING'S DISEASE WITH RADIOACTIVE GOLD AND RADIOACTIVE YTTRIUM. Joplin, G. F. (Postgraduate Medical School, London). Acta Isotop., 4: 347-54(1964).

A total number of 23 patients with Cushing's syndrome were treated with pituitary implantation. The first half of the series were treated by means of ^{198}Au seeds alone, the second half had implants of both ^{198}Au and ^{90}Y sources. The activities in each group of patients were planned to give a dose of 10,000 rads at the diaphragm sella. There was no response in the two patients with adrenal tumors. Seven patients with adrenal hyperplasia responded satisfactorily. Six patients showed either an incomplete response, or relapsed, after a temporary response. Four showed no response at all. The patients with pituitary tumors were less responsive to the irradiation. Four patients had a second implant. Results were entirely satisfactory in two. (H.G.D.)

8754 TECHNIQUE AND RESULTS OF THE INTERSTITIAL RADIO-THERAPY OF THE HYPOPHYSIS IN DIFFERENT ENDOCRINE SYNDROMES: CHROMOPHOBE ADENOMA, ACROMEGALY AND CUSHING'S DISEASE. Talairach, J.; Bonis, A.; Szikla, G.; Covello, L. (Hopital Sainte-Anne, Paris). Acta Isotop., 4: 355-85(1964). (In Italian).

The use of interstitial γ-therapy with ^{198}Au and ^{192}Ir in non-tumoral acromegaly, Cushing's disease, and chromophobe adenoma is discussed. Interstitial radiotherapy is preferred to external irradiation because it gives smaller doses to the surrounding tissues (chiasma, hypothalamus). Precise dosimetry is required. The improvement of all symptoms is achieved without considerable risk. (H.G.D.)

8755 PRELIMINARY RESULTS FROM TREATMENT OF JUVENILE DIABETICS WITH PROGRESSIVE VASCULAR COMPLICATIONS AND NEUROPATHY BY IMPLANTATION OF THE HYPOPHYSIS WITH RADIOACTIVE YTTRIUM. Luft, R.; Notter, G. (Karolinska Sjukhuset, Stockholm). Acta Isotop., 4: 387-98(1964).

The technique for destruction of the hypophysis by implantation of radioactive yttrium spheres is described, and the clinical results after radiological destruction of the hypophysis in 11 diabetic children with progressive vascular complications and neuropathy are reported. Total destruction of the hypophysis was achieved in 7 of 11 patients according to the clinical tests. It was concluded that: hypophysectomy may arrest the progression of diabetic retinopathy and improvement in visual acuity may occur; hypophysectomy decreases insulin requirement and the tendency to metabolic acidosis but increases the risk for hypoglycemia; hypophysectomy does not influence diabetic neuropathy and vascular calcifications but seems to stop the progression of nephropathy. (auth)

8756 PERCUTANEOUS ^{182}Ta WIRE IMPLANTATION USING A GUIDING-NEEDLE TECHNIQUE FOR HEAD AND NECK TUMORS. Son, Yung H.; Ramsby, Gale R. (Yale Univ., New Haven). Amer. J. Roentgenol., Radium Therapy Nucl. Med., 96: 37-44(Jan. 1966).

An improved technique of ^{182}Ta wire implantation through a percutaneous route is discussed. This technique was used in six patients who had recurrent or extensive lesions in the head and neck area. Tantalum-182 wire implantation was carried out as an adjunct to external beam therapy, chemotherapy or radium needle implantation. New instruments, such as a lead jig, guiding-needle, needle-holder, and space-maintainer are described. The technique was satisfactorily tried in four cases under local anesthesia. Expediency of the technique and adequate shielding minimized the exposure hazard. This technique was found applicable to a complex tumor volume in areas otherwise inaccessible. (TCO)

8757 INTRACAVITARY RADIATION THERAPY OF CANCER OF THE UTERINE CERVIX BY REMOTE AFTER-LOADING WITH CYCLING SOURCES. Henschke, Ulrich K.; Hilaris, Basil S.; Mahan, G. David (Memorial Sloan-Kettering Cancer Center, New York). Amer. J. Roentgenol., Radium Therapy Nucl. Med., 96: 45-51(Jan. 1966).

Remote afterloading with cycling sources is analyzed for its usefulness in the treatment of cervical cancer. Intracavitary radiotherapy is considered essential for cervical cancer treatment. No evidence is available to show that the same results can be accomplished by transvaginal or external roentgen therapy. It is suggested that radiation exposure of personnel from intracavitary sources can be completely eliminated by use of the technique. (H.G.D.)

8758 EVALUATION OF METHODS OF COMPUTER ESTIMATION OF INTERSTITIAL AND INTRACAVITARY DOSIMETRY. Powers, W. E.; Schneider, Aleene, K.; Shumate, Kaye; Fotenos, Helen; Gallagher, Tom (Washington Univ., St. Louis). Amer. J. Roentgenol., Radium Therapy Nucl. Med., 96: 59-65(Jan. 1966).

Various existing and publicly available computer programs for interstitial and intracavitary dosimetry were compared. All of the programs are adequately accurate for the clinical problems that they solve. (auth)

8759 DESIGN OF A UNIVERSAL WEDGE FILTER SYSTEM FOR A ^{60}Co UNIT. Aron, Bernard S.; Scapicchio, Michael (State Univ. of New York, Brooklyn. Kings County Hospital Center, Brooklyn). Amer. J. Roentgenol., Radium Therapy Nucl. Med., 96: 70-4(Jan. 1966).

The method used to design and construct a universal wedge filter system for a cobalt-60 unit is described. The system is universal in that all field sizes may be used with a single wedge filter for a particular wedge angle. These wedge filters and their isodose curves may easily be calculated and constructed. (auth)

8760 EVALUATION OF TOLERANCE DURING TREATMENT, LATE TOLERANCE, AND BETTER EVALUATION OF CLINICAL EFFECTIVENESS OF THE ^{60}Co MOVING STRIP TECHNIQUE. Delclos, Luis; Murphy, Margaret (Univ. of Texas, Houston). Amer. J. Roentgenol., Radium Therapy Nucl. Med., 96: 75-80(Jan. 1966).

Tolerance to abdominal irradiation by the moving strip technique is evaluated. It is shown that a dose of 2800 rads can be delivered to each segment of the abdomen in 12 days with local systemic reactions kept within safe limits during the treatment. Data on patients in which the technique was used for ovarian carcinomas, lymphomas, or seminomas are tabulated. No kidney or spinal cord sequelae were observed. (H.G.D.)

8761 RESULTS OF ^{60}Co ROTATION THERAPY IN CARCINOMA OF THE CERVIX. Koeck, George P.; Jacobson, Lillian E.; Hillsinger, William R. (United Hospitals of Newark, N. J.). Amer. J. Roentgenol., Radium Therapy Nucl. Med., 96: 81-91(Jan. 1966).

A method of treating cervical carcinoma with a cobalt-60 teletherapy machine, using 360° rotation, and irradiating a larger and then a smaller volume in the pelvis is described. Isodose curves are given for the dose distribution in a body cross section, in percent of tumor dose and in R for the following conditions: when a tumor receives 4,000 R; 3,000 R with the smaller field; a combination of the two; and a combination of 5,000 R to the larger field and 3,000 R to the smaller field. An analysis is made of 55 cases, giving a pathology of the tumor, the stages of the disease, the marital status, the number of pregnancies, the symptoms which brought the patient to the physician, and the age distribution. The survival rates are given and compared with those of other investigators using radium and external irradiation. Reactions due to therapy are described. Surgical procedures post therapy are discussed. Methods by which improvement in isodose distribution may be obtained are presented. (TCO)

8762 EFFECT OF A STAINLESS STEEL MESH SKULL PROSTHESIS ON THE DEPTH DOSE DISTRIBUTION OF 200 kv. ROENTGEN RAYS, ^{60}Co, AND HIGH ENERGY ELECTRON BEAMS. A PRELIMINARY STUDY OF BRAIN IRRADIATION AFTER STEEL MESH CRANIOPLASTY. Tosi, G. P. (Clinica S. Ambrogio, Milan); Columella, F.; Delzanno, G. B.; Gaist, G.; Piazza, G. Amer. J. Roentgenol., Radium Therapy Nucl. Med., 96: 137-40(Jan. 1966).

The present investigation concerns the modifications induced on the irradiation depth dosage by stainless steel mesh (as used for cranioplasties), when the mesh is interposed on the radiation beam (32 mev electron beams, ^{60}Co, 200 kv x rays). The study was conducted in order to assess which type of radiation therapy is to be preferred after stainless steel mesh cranioplasty. The mesh was found to have a considerable screening effect on 200 kv x rays and to cause a modification in their homogeneity. A minimal screening effect was observed on 32 Mev electron beams, and their homogeneity was modified by the mesh only for 1.5 to 2 cm. The presence of the mesh induced practically no modifications on ^{60}Co radiation beams. It is concluded that whenever radiation therapy of the brain is to be used on patients with stainless steel mesh cranioplasty, electron beam or ^{60}Co radiations are preferred over conventional x rays. (auth)

8763 ORGAN VISUALIZATION USING SCINTILLATION CAMERA TECHNIQUES. Schaer, Leonard R.; Anger, Hal O. (Univ. of California, Berkeley). Ann. Internal Med., 63: 442-53(Sept. 1965).

The design and operation of the scintillation camera, a new electronic instrument for taking radioisotope pictures of internal organs without scanning, are described and illustrated. It contains an 11½ in. diameter by ½ in. thick NaI crystal viewed by a hexagonal array of 19 3-in. diameter photomultiplier tubes. Scintillations produced in the crystal by γ rays are shown on an oscilloscope as bright flashes of light that correspond in position with the original scintillations. These flashes are recorded on film. If positron-emitting isotopes are used, γ-ray collimators can be eliminated and improved sensitivity and resolution obtained. In most instances the entire organ can be exposed at one time. Each exposure is of relatively short duration. When short half-life isotopes are used, high sp act. can be injected and excellent pictures obtained with exposures lasting only a few sec. In most studies, however, exposure time is 4 to 5 min. When reduction of radiation dose is desired, the exposure time can be lengthened to compensate for the smaller quantity of radioactive material injected. The clinical uses of the scintillation camera are illustrated. Brain tumor suspects can be examined using ^{68}Ga (68 min. half-life) ethylenediaminetetraacetic acid as the tracer. Technetium-99m (16.04 hr half-life) is another short half-life isotope that is advantageously used with the scintillation camera. Using ^{203}Hg-bromomercurihydroxypropane, excellent visualization of the spleen is possible. Fluorine-18 (1.8 hr. half-life), a positron emitter, has been employed to demonstrate bone tumors and other abnormalities. By administering ^{52}Fe, another positron emitter, the distribution of functioning bone marrow can be demonstrated. (BBB)

8764 PITUITARY ABLATION BY ^{90}Y IMPLANTATION FOR ADVANCING DIABETIC RETINOPATHY: A PRELIMINARY REPORT. Cullen, J. F.; Harris, P.; Turner, J. W.; Donaldson, A. A.; Munro, J. F.; Duncan, L. J. P. (Royal Infirmary, Edinburgh). Brit. J. Opthalmol., 49: 405-12(Aug. 1965).

A radioisotope procedure for destruction of the pituitary is described, with precautions necessary to prevent injury to adjacent structures. Results and complications occurring in 10 patients are reported. Where complete ablation of the normal gland by means of radiation is desired, ^{90}Y is the material of choice because of its intense but localized β radiation. Under general anesthesia, and using two image intensifiers, one anteroposterior and one lateral, a trocar and cannula were inserted and guided to the anterior part of the floor of the pituitary fossa, which was punctured, and a threaded hole was made, using a special rod and screw. The gland capsule was then perforated by a special stilette and the rod of ^{90}Y, on its stainless steel screw, was screwed into position, thus minimizing the risk of cerebrospinal fluid leaking through the trocar and cannula hole. The same procedure was carried out on the opposite side, the two rods being placed parallel to the diaphragma. Hormone replacement therapy was given as required and insulin doses adjusted according to the appropriate blood and urinary glucose estimations. In nine patients a significant fall in insulin requirements occurred, suggesting satisfactory pituitary ablation, although the results of the thyroid-stimulating hormone and gonadotrophin assays have yet to be evaluated. In these patients the improvement in vision and in the retinopathy was comparable to that achieved by pituitary-stalk section, but developed less rapidly. Yttrium-90 is a simpler and potentially safer method of inducing pituitary insufficiency in diabetics than either surgical hypophysectomy or stalk section. (BBB)

8765 AN ASSESSMENT OF THE VALUE OF RADIOTHERAPY IN THE MANAGEMENT OF CARCINOMA OF THE PROSTATE. Budhraja, S. N.; Anderson, J. C. (United Sheffield Hospitals, Eng.). Brit. J. Urol., 36: 535-40(Dec. 1964).

In 81 cases of prostatic cancer the effectiveness of external radiation combined with surgery and stilbestrol treatment was compared with combined surgical and endocrine treatment. A three-year survival of 60% was achieved in the radiotherapy group, whereas in the non-radiotherapy group it was 43%. Five-year survival rates were 25% and 28% respectively. The difference between the two groups was not considered significant. (TCO)

8766 RADIOTHERAPY IN THE TREATMENT OF CARCINOMA OF THE PENIS. Murrell, D. Shirley (Sheffield National Centre for Radiotherapy, Eng.); Williams, J. L. Brit. J. Urol., 37: 211-22(Apr. 1965).

Use of various types of radiation to treat 108 patients is described, as well as the resulting radiation-caused complications. Stage I and II patients had a full radical course of radiotherapy in all but seven patients, where a palliative or incomplete course only was achieved. Parallel opposed fields treating the whole penis were used in 75 cases, and a single direct field to a superficial lesion in 17 cases; 250-kv x rays were used for 81 cases, 140-kv x rays for five cases, and 2-Mev or ^{60}Co irradiation in six cases. Treatment was given at the rate of 1000 R per week, five days a week except in some early cases treated on three days a week. The dose given varied between 3000 rad in 21 days and 6700 rad in 44

days. Therapeutic results and complications after radiotherapy are listed. (TCO)

8767 CHILDHOOD THYROID CARCINOMA. Winship, Theodore; Rosvoll, Randi V. (Washington Hospital Center, D. C.). Cancer, 14: 734-43(Aug. 1961).

An attempt was made to evaluate the etiologic role of radiation in 562 cases of childhood thyroid carcinoma collected from all parts of the world. A definite increase in the incidence of this disease is shown, being most marked between the years 1945 and 1957. Attempts were made to obtain a history of previous irradiation in only 277 patients. Of this group, which represents less than half of the entire series, a history of irradiation was obtained in 221 patients or about 80%. In the greatest number of cases, x ray therapy during infancy was directed to the upper mediastinum for a so-called enlarged thymus gland. The next largest group consisted of those treated during childhood for hypertrophied tonsils and adenoids. Others were treated for hemangiomas, nevi, acne, eczema, so-called cervical adenitis, and numerous other benign lesions. One patient had numerous exposures to x rays because of a cardiac anomaly. Three other patients each had x ray therapy for a brain tumor, a retinoblastoma, and a lymphoma. The dose of x rays was only estimated in some cases, and it is probable that the thyroid gland received an amount of irradiation within the range of 500 to 800 R. The dose administered varied from 180 to 6000 R, with an average of 600 R. The interval between the irradiation and the diagnosis of thyroid cancer averaged 8.7 years with extremes of 3.6 to 14 yr. In contrast, the interval for adults was 15 to 40 yr. Thymic irradiation was most popular and most widely used between 1920 and 1940. Factors other than irradiation influence the production of thyroid carcinoma, and the data presented here do not prove that x rays during infancy cause thyroid cancer, but an obvious correlation was evident. (BBB)

8768 RADIOSENSITIVITY STUDIES IN TREATMENT OF CANCER OF THE CERVIX. Merrill, James A. (Univ. of Oklahoma, Oklahoma City. Univ. of California, San Francisco). Cancer, 19: 143-8(Jan. 1966).

One hundred-ninety-two patients with cervical cancer treated by primary radiotherapy during the years 1957 through 1960 were studied by SR, serial RR, and serial cervical biopsies. It was impossible to demonstrate any value of SR as a prognostic index. Patients with good RR have a higher survival rate than patients with poor RR, but the differences are not statistically significant. RR is influenced by numerous factors. The prognostic accuracy of examining cervical biopsies is greater than with the cytologic techniques, and differences in survival rate are statistically significant. It is concluded that radiosensitivity testing techniques offer little advantage in the clinical management of patients with cancer of the cervix. (auth)

8769 COMBINED RADIATION-CHEMOTHERAPY FOR BRONCHOGENIC CARCINOMA—PILOT STUDY. Hosley, Henry F.; Marangoudakis, Stavros; Ross, Charles A.; Murphy, Walter T.; Holland, James F. (Roswell Park Memorial Inst., Buffalo). Cancer Chemotherap. Rep., 16: 467-72(Feb. 1962).

A pilot study was undertaken to determine the practicability of administering Methotrexate, 5 mg; 5-fluorouracil (FU), 5 mg/kg; and actinomycin D, 4 μg/kg, daily, together with 2-Mev x radiation. The objectives were to find drugs that potentiated radiation therapy in doses that could be taken safely, to establish the relative toxicity of combined therapy, and to determine certain biochemical characteristics of the disease and how they modified the response to therapy. The study was designed to compare the effect of a drug plus an optimal dose of x radiation with an optimal dose of radiation alone in the treatment of the same disease. The total dose varied because of interruptions of therapy, for various causes; however, in all 27 patients who completed therapy, an attempt was made to give a dose biologically equivalent to a 4000-rad depth dose in 30 days. Actinomycin D, FU, or Methotrexate was administered for two days before radiation therapy and daily, 5 days a week, one hour prior to radiation. At least 3 radiation treatments were given in the first week. Each patient developed erythema of the skin in the irradiated area. In two patients, however, unusual skin reactions were noted. One patient on Methotrexate had a transient bullous dermatitis and one patient on actinomycin D had a localized exfoliative dermatitis. Particular attention was given to the occurrence of the pulmonary reaction secondary to radiation. (BBB)

8770 THE PREPARATION AND TESTING OF LABELED o-IODOHIPPURIC ACID FOR DIAGNOSTIC PURPOSES IN NUCLEAR MEDICINE. Eysselt, Milos (Medical Faculty Univ., Brno). Cesk. Radiol., 18: 311-17(Sept. 1964). (In Czech).

A new technique for the synthesis of ^{131}I-labeled o-iodohippuric acid for use in diagnosis is described. Starting with the diazotization of anthranilic acid, formation of o-iodobenzoic acid, treatment of the acid with thionyl chloride, and reaction with glycine to yield unlabeled o-iodohippuric acid, is described. The method of Sheer and Meier-Borst for exchange of ^{131}I to label this compound is recommended because of its simplicity, and the yield of compound with high specific activity. Tests for control of the compound for safety in man are proposed. (BBB)

8771 THE STUDY AND ANALYSIS OF RADIOCHROMATOGRAMS FOLLOWING ^{131}I ADMINISTRATIONS TO HUMANS. Horwitz, H.; Kereiakes, J. G.; Goldsmith, R. E.; Pollack, S. V. (Univ. of Cincinnati). Int. J. Appl. Radiat. Isotop., 16: 721-6(Dec. 1965).

An automated approach to the digitization, analysis, and storage of radiochromatographic information is presented. The method incorporates statistical evaluation and graphical display of fully processed data thereby facilitating interpretation and increasing the potential clinical and research applications of radiochromatography in thyroid disease. (auth)

8772 TREATMENT OF THYROID CARCINOMA WITH ^{131}I: RESULTS AT FOURTEEN YEARS. Haynie, Thomas P.; Nofal, Mohamed M.; Beierwaltes, William H. (Univ. of Michigan, Ann Arbor). J. Amer. Med. Ass., 183: 303-6(Feb. 2, 1963).

The late effects of the use of ^{131}I to treat thyroid carcinoma were examined in 200 cases followed for 14 yr, with attention to clinical benefits and side effects. All patients had been submitted to thyroidectomy before ^{131}I treatment. (TCO)

8773 CAN THE RESULTS BE IMPROVED BY COMBINING RADIATION AND ELECTIVE RADICAL HYSTERECTOMY AND LYMPHADENECTOMY? Greiss, Frank C. Jr. (Wake Forest Coll., Winston-Salem, N. C.). J. Amer. Med. Ass., 193: 105(Sept. 27, 1965).

Although some investigators believe that survival after surgical resection of nodal metastases in cervical cancer is improved following radiation therapy, the literature shows marked variation in survival and averages which are about the same as those after primary radical surgery alone. Primary radiation therapy complements elective radical surgery by reducing pelvic inflammation and tissue necrosis and by reducing pelvic inflammation and tissue necrosis and by reducing the size of the primary tumor mass. In addition, general experience supports the view that radiation therapy may destroy up to 50% of nodal metastases. A plan of individualized therapy for patients with cervical carcinoma is described. Patients receive a full course of radiation therapy with intracavitary radium and external 220-kv x irradiation. If the tumor response is good and the patient less than 60 years old without other disease, a radical hysterectomy and a pelvic lymphadenectomy are performed about four months later. Tumors that failed to respond to radiation or progressed during therapy are considered to be inoperable. Although overall experience with complemental radical surgery for stage III carcinoma of the cervix is not significantly better than after radiation alone, the results in the group having surgery indicate that more patients must be treated before definite conclusions can be made. (BBB)

8774 NUCLEAR MEDICINE: PAST AND PRESENT. Loken, Merle K. (Univ. Minnesota Hospital, Minneapolis). J.-Lancet, 85: 431-4(Oct. 1965).

Use of radioactive materials in medical diagnosis and treatment is reviewed, with emphasis on the variety of radionuclides and labeled compounds available, developments in instrumentation, attendant hazards of use of these materials, and possible future developments in this field. Consideration is given to the availability of radioactive materials, to the availability and performances of devices for measurement of radioactivity, and to the radiation hazard to patients and clinic personnel. The sensitivity of nuclear instruments determines in part the amount of radioactivity which must be administered to a patient in order to perform a particular study. Radiation exposure to the patient is significantly less when radioisotopes are used than that associated with most x-ray procedures, particularly those which include fluoroscopy. Radioactive materials with short lives can be used to distinct advantage, since larger doses of these radioactive materials may be administered to patients within limits of acceptable radiation exposure and information on transport or localization of these isotopes may be obtained relatively quickly. One of the few such materials presently available is ^{99m}Tc which is a decay product of ^{99}Mo. Localization of radiotechnetium as pertechnetate ion in brain tumors, salivary glands, and stomach is discussed. It is concluded that radioisotopes afford a convenient and reliable tool for the visualization and evaluation of the function of various body organs. (TCO)

8775 BIOLOGICAL AND PHYSICAL FACTORS IN THE RADIOTHERAPY OF CARCINOMA OF THE CERVIX. Walter L. (Hammersmith Hospital, London); Glucksmann, A.; Cherry, C. P. J. Obstet. Gynaecol. Brit. Commonwealth, 72: 575-85(Aug. 1965).

The cellular effects of ionizing radiation were examined in a study of 420 patients undertaken primarily to test whether routine pathologic examinations of serial biopsy specimens taken before and during radiation treatment of patients with cervical carcinomas could help in the early assessment of the response of the tumor to treatment in the individual patient. The results showed highly significant differences in the 5-yr symptom-free survival rates of patients with early favorable radiation reaction at the primary site and of those showing little or no early reaction. The effect of the type and dose of radiation given in relation to tumor cell response was evaluated. Radium implantation and conventional x-ray treatment were used. With Ra, an estimated dose of 2000 R to point A was given in each of three insertions. A biopsy was taken before the radium was inserted for assessment of the radiation response. The radium was supplemented by x-ray therapy in the 200 to 250 kv range in most stage 3 and 2 cases and in some of those in stage 1, and treatment usually began shortly after the second radium insertion. Incomplete treatment had an adverse effect on radiocurability in stages 1 and 2 but not in stages 3 and 4, while x-ray therapy in addition to complete Ra treatment significantly increased the survival rate in stage 3 but not in stages 1 and 2. Insufficient dose to responsive tumors in the earlier clinical stages and the curative effect of supplementary x-ray therapy to responsive distant node deposits in stage 3 cases is suggested as explanation for these results. Evidence is presented to show that failure of radiotherapy in the later clinical stages is due also to an increase in the proportion of refractory tumors at the primary site with advancing stage of the disease. (BBB)

8776 COMPARATIVE RESULTS OF THE TREATMENT OF INOPERABLE LUNG CARCINOMAS WITH TELECOBALT THERAPY AND 200-kv ROENTGEN THERAPY. Jacob, P.; Abbatucci, J. S.; Robillard, J.; Mouchel, A. (Centre Regional de Lutte Contre le Cancer, Caen, France). J. Radiol., Electrol. Med. Nucl., 46: 465-9(Aug.-Sept. 1965). (In French).

The therapeutic results obtained with 200 kv were identical with others previously obtained. It appeared that telecobaltherapy of inoperable lung carcinomas does not procure a notable improvement in the results obtained with regard to survival whatever the tumor dose exceeding 5000 R may be. In the treatment of inoperable bronchial carcinomas, telecobaltherapy was considered because of the greater comfort offered to the patient. The main advantage of such a treatment is a possible increase in the possibilities of radio-surgical association. (auth)

8777 THE BASIS OF THE MULTISCINTIGRAM SYSTEM AND ITS CLINICAL APPLICATIONS. Ozeki, M.; Furukawa, Y.; Moriyama, T.; Matsushita, H.; Tsukamoto, M.; Kohi, T. (Kurume Univ. School of Medicine, Japan). Kurume Med. J., 11: 149-66(1964).

The authors describe and illustrate results of the multiscintigram procedure they have developed. The apparatus consists of four scintigram recording circuits, each with its own dot tapper and count rate control. Each scintigram is recorded as a ring-shaped pattern, except for the circuit driven at the maximum count rate. Thus, each scintigram indicates the distribution of an isocount rate. Each of the records obtained can be recorded in a characteristic color code. The records are superimposed, one on the other, resulting in a color pattern of relative activity concentration. Clinical applications of the method to brain tumor scintigrams has given an accuracy of 76.4% in diagnosis, as confirmed by histological classification. This method of scintigraphic scanning also has value in studies of the thyroid, liver, kidney, and lung. The authors contend that this method may increase the accuracy of clinical diagnosis as compared to monochromatic scanning with a single recording channel. (BBB)

8778 AN OBSERVATION OF A HEMORRHAGIC SYNDROME CAUSED BY PERSISTANT THROMBOCYTOSIS AFTER A SPLENECTOMY: TREATMENT BY ^{32}P. Croizat, P.; Bothier, F.; Girard, R. Lyon Med., 213: 977-81 (Mar. 28, 1965). (In French).

A 50-year-old woman was hospitalized several times over a period of years with gingival bleeding, megakaryocytosis, and thrombocytosis. She had undergone splenectomy eight months before the first post-operative hospitalization. Standard treatment proved unsuccessful, so she was given five mC of ^{32}P. The effect of ^{32}P treatment on blood coagulation parameters was studied. A thromboelastogram made before treatment showed coagulation reaction time (r) of 14 units, coagulation speed (k) of five units, maximal elasticity (E_{max}) of 488 mm, and maximal elasticity time (T) of 75 units. For normal blood the figures are: r = 16, k = 7, E_{max} = 130, and T = 80. About six weeks after receiving the ^{32}P, r was 16, k was 7, E_{max} was 317, and T was 75. Thus, reaction time and coagulation speed had returned to normal. The time of maximal elasticity was almost normal, and the elasticity had dropped 171 units. The number of platelets fell from over one million to 318,000 per mm^3 in the same period. The ^{32}P treatment also brought about a rapid disappearance of hemorrhages. (BBB)

8779 THERAPEUTIC USES OF RADIOIODINE. Asper, Samuel P. Jr. (Johns Hopkins Hospital, Baltimore); Rall, Joseph E. Maryland State Med. J., 10: 126-30(Mar. 1961).

Some cases are cited showing instances when radioiodine was useful therapeutically, with a description of the radiation-induced complications that occurred in some of these cases. Only a few patients with carcinoma of the thyroid are suitable candidates for treatment with ^{131}I. Use of radioiodine in treating hyperthyroidism and the attendant hazards are also examined. (TCO)

8780 ARTIFICIAL INTENSIFICATION OF THE RADIOACTIVITY OF THERAPEUTIC WATERS. Szabo, A. (Institutul de Fizica Atomica, Sectia Cluj, Cluj). Med. Interna, 15: 1141-9(Sept. 1963). (In Rumanian).

It is important to estimate the effectiveness of various techniques for obtaining radioactive waters of greater irradiating intensity. These artificial waters yield physio-

logical effects identical to those of natural radioactive waters in balneological treatments and should be important in cases where accurately measured radiation effects of higher intensity are needed. Three methods for increasing activity of water are known: intensification with Rn obtained by air bubbling of solutions of $RaCl_2$, which allows 200 Mache unit solutions to be prepared from 10 mg Ra. The second method is concentration of Rn in naturally radioactive waters with a high radioactivity. This allows solutions to be prepared with 4-5 Mache units per liter of air. Finally, activation by diffusion, using solid Ra preparations, is suggested to be the most convenient, since it may be operated without a permanent control by the specialized personnel. A scheme for intensification by this method is illustrated; 95 to 96% of the equilibrium Rn (between water and air) may be obtained, giving water of 10,000 Mache units at about 2 liters/hour from a 10 mg Ra sample. (BBB)

8781 PROBLEMS OF RADIOLOGICAL PROTECTION CONNECTED WITH THE USE OF ^{165}Dy IN MEDICINE. Ilari, O.; Tagliati, S. (CNEN, Rome). Minerva Nucl., 9: 132-6(May-June 1965). (In Italian).

The results of physical measurements (decay curves, gamma spectra, dose intensity measurements, etc.) carried out on samples of ^{165}Dy obtained by irradiating ^{164}Dy with thermal neutrons are reported. A typical experiment carried out on animals analyzing contemporaneously the radiological risks connected with the various phases of the experiment is described. The conclusions drawn from the animal experiments are extended to the case of using ^{165}Dy in the therapy of human tumors. (tr-auth)

8782 EFFECT OF AUTORADIOLYSIS ON THE RENAL CLEARANCE OF ^{131}I LABELED HYPAQUE AND HIPPURAN. Bianchi, G. (Univ., Pisa, Italy); Hegesippe, E.; Meozzi, A.; Rosa, U.; Sosi, S. Minerva Nucl., 9: 152-6(May-June 1965).

Radioiodine ^{131}I labeled hypaque (3-5 diaceticamino 2-4-6-triiodo benzoic acid, sodium salt) and hippuran (o-iodobenzoic acid, sodium salt) are widely used in the study of renal function. Hypaque is eliminated by the kidneys through the glomeruli only and the measurement of the glomerular filtration rate can, therefore, be carried out easily by administering labeled hypaque. Hippuran is eliminated through both glomeruli and tubules, and allows the measurement of renal plasma flow. When, in the solutions of radioiodine-labeled hypaque and hippuran, a fraction of the radioiodine is present in inorganic form (elemental iodine or I^-), the usefulness of these tracers in the study of renal function is severely limited. This may be explained by the fact that, when free iodine is present, the apparent rate of elimination of the radioiodine-labeled tracers becomes smaller, the clearance values so measured being no longer correlated with a given set of pathological conditions. The formation of inorganic iodine in the hypaque or hippuran solutions may be the result of decomposition reactions unrelated with radioactivity, or (more probably considering the well-known high chemical stability) of autoradiolysis. Whatever the origin, the changes of the clearance values, in the presence of free iodine, are significant. Results are reported from a study carried out with the purpose of finding whether, by changing in some way the conditions of preparation and storage of the labeled molecules, this effect can be minimized. (tr-auth)

8783 A PRACTICAL TECHNIQUE FOR DOSE EVALUATION IN RADIOYTTRIUM IMPLANT INTO THE HYPOPHYSIS. Buraggi, G. L. (Univ., Milan. Istituto Nazionale per lo Studio e la Cura dei Tumori, Milan). Minerva Nucl., 9: 180-3(May-June 1965). (In Italian).

A practical method for evaluating B doses obtained by ^{90}Y implant into the pituitary hypophysis is described. A graphic reproduction of the implant obtained by suitable radiograms taken in orthogonal views is required. Valuable help is also given by a graph reproducing the dose levels obtained by the substance at the various distances. From this graph it is possible to deduce the dose level of interest, and also the distance at which such a dose is obtained. This would make it possible to draw the isodose curve related to this value and to calculate the volume in which this dose or a higher one is obtained. The result of this volumetric evaluation can be usefully expressed in percentage of hypophyseal volume. Clinical and autopsy findings were found to agree satisfactorily. (tr-auth)

8784 A SURVEY ON THE HISTORY OF PRIOR MEDICAL IRRADIATION IN THE GENERAL POPULATION OF JAPAN. Kitabatake, Takashi; Onuma, Isao; Morita, Kozo; Koga, Sukehiko; Okajima, Shunzo (Nagoya Univ. School of Medicine, Japan). Nagoya J. Med. Sci., 27: 105-11(Dec. 1964).

Preliminary to a study on late effects following medical irradiation, it was necessary to determine the rate of prior medical irradiation in the general population. This rate was studied in population in Aichi Prefecture before extending the results to the general population of Japan. This study was carried out as a part of a national survey on carcinogenesis in man in Japan. Questionnaires were sent to 1000 persons selected randomly among the population in Aichi Prefecture. Among the usable responses (869 or 86.9%), 57 or 6.56% have a history of prior medical irradiation more than three years ago. The irradiation rate was higher in males (9.03%) than in females (4.12%). Little difference of irradiation rate was seen in relation to age. An analysis of nonresponses showed no particular bias in this survey. Results obtained in this survey also showed that the control group adopted for the research project of human cancer induced by medical radiation had no statistical biases for obtaining reliable inferences on radiation-induced carcinogenesis in man. Of the irradiated persons, 47 received fluoroscopic examination of the gastrointestinal tract, and 10 received radiation therapy. Thus, only 1.16% of the irradiation was received for therapeutic reasons. (BBB)

8785 ESTIMATION OF RADIOTHERAPEUTIC DOSE GIVEN FOR RADIOTHERAPY OF BENIGN DISEASES IN THE PAST IN JAPAN. Kitabatake, Takashi; Okajima, Shunzo (Nagoya Univ. School of Medicine, Japan). Nagoya J. Med. Sci., 27: 112-18(Dec. 1964).

An estimation was made of radiation doses given for radiotherapy of benign tumors and various other benign diseases in the past in Japan, by surveys of existing radiotherapeutic literature and a hospital survey method. Radiation conditions examined included x-ray quality, exposure, time, focus-skin distance, type of rectification, filter, and dose, as collected from 98 Japanese publications classified according to disease and decade. Also, questionnaires were sent to senior radiologists and x-ray technicians in large hospitals in Japan, which were requested to report the radiation conditions used for various benign diseases, according to decade. From these data the lower and upper limits and average radiation doses given for different benign diseases were calculated and tabulated. Hospital surveys may have had a defect in that most answers were based on radiologists' memories. Such a memory bias may tend to lower the reported dose. On the other hand, radiation data collected from literature may offer a more accurate pattern of radiotherapeutic doses. Therefore, a comparison of total dose and quality of x rays used for tuberculous cervical lymphadenitis was made between data obtained from the literature and from the hospital survey. The results showed that data collected from the literature and from hospitals coincided completely. Therefore, data collected from hospitals were mainly used for dose estimation. (BBB).

8786 THE USE OF RADIOACTIVE MATERIALS IN MEDICINE. Semiller, H. A. Neue Tech., 5: 235-7(1965). (In German).

The uses of radioactive materials in medicine are illustrated by examples from endocrinology and from the diagnosis and therapy of blood diseases. (J.S.R.)

8787 A SIMPLE MEANS OF ANATOMIC CORRELATION OF THE PHOTO DOT SCAN. Mishkin, Fred (Indiana Univ., Indianapolis). New Engl. J. Med., 273: 262-5(July 29, 1965).

A method was developed for precise anatomic correlation of tumors detected by scanning with their radiographic location, facilitating surgical exploration of the lesion. The roentgenogram is exposed at the same geometry and projection in which the scan is made by mounting the x-ray tube beneath the scanning table. The scan is performed using the same film with its latent image and double exposing it with the scan. Thus, the skull and photoscan are on one convenient film. Or, duplicating film can be used to provide a similar convenient anatomic correlation. The completed photo dot scan (made with a Picker Magnascanner) is superimposed over a routine 36-in. skull film in the usual straight antero-posterior or posteroanterior frontal projection and the appropriate lateral view. Anatomical landmarks are chosen for exact superposition. The photoscan is then fastened firmly with tape to the roentgenogram, and the doubled films are closely applied to single-emulsion radiograph-duplicating film. This triple-decker sandwich is then fed into a roentgenogram duplicator. This provides a convenient anatomic correlation of the scan on a single film suitable for viewing or display. Not only is the procedure useful for brain scans, but with the use of appropriate landmarks or the use of lead shot, records of scans of other parenchymal organs can be obtained. (TCO)

8788 EVALUATION OF THE EFFECTIVENESS OF ^{60}Co TELETHERAPY OF PERIUTERINE RECURRENCES IN PATIENTS PREVIOUSLY IRRADIATED FROM UTERINE CANCER. Nowakowski, Wladyslaw (Instytut Onkologii, Warsaw). Nowotwory, 14: 27-32(Jan.-Mar. 1964). (In Polish).

The use of ^{60}Co teleirradiation in recurrent carcinoma of the uterus in 48 women is described, with details on clinical results and incidence of complications, particularly in comparison with those occurring in primary cancer treated by radiation. The age of the patients ranged from 33 to 71 yr, 55% being in the 6th decade or older. Treatment was given in 150-R daily doses to total doses averaging 2500 R (range 1144 to 4393 R). In some cases where infection was present, intensive antibiotic therapy was applied. The 3-yr survivors numbered 9 out of the total of 48 patients. A correlation of the doses used with secondary remission time showed that total doses in the range 2500 to 3000 R were more effective in prolonging life than 2000-R doses. A comparison of the incidence of severe complications showed that treatment of recurrences is associated with fewer complications than is primary radiotherapy. Thus, there were three cases of severe radiation injury, arising 2, 16, and 24 months postirradiation, giving a complication rate of only 10.4% as compared with a rate of 26.5% in the same clinic for primary ^{60}Co treatment. (BBB)

8789 COMPARISON OF TASTE SENSITIVITY IN PATIENTS SUBJECTED TO RADIOLOGICAL TREATMENT WITH HIGH ENERGY OF TUMORS OF THE ORAL CAVITY. Bonanni, G.; Perazzi, F. (Univ., Rome). Nunt. Radiol., 31: 383-97(Apr. 1965). (In Italian).

Changes of the taste induced by radiation in patients undergoing x ray treatment with high energies for tumors of the oral cavity and of the upper respiratory tract were studied in one hundred and seven subjects. Twenty of these, being healthy or free from any diseases connected with the buccalpharyngeal cavity, were selected and utilized as controls. The results were compared before and after the x ray treatment; 50 patients were examined one month after radiotherapy and 15 after one year. The results were examined from the clinical, statistical, and histological standpoint. Changes of the taste sensitivity observed after the x ray treatment indicated that, in most cases, it was diminished for one or more flavors. It was found, however, that there may coexist changes for the other savors both in the sense of a dysgeusia and of an increased sensitivity for one flavor. Homogeneous change in sensitivity for all flavors was rarely observed. The controls examined one month and one year after radiotherapy showed a complete restoration of taste sensitivity. (tr-auth)

8790 POSTIRRADIATION SARCOMAS OF THE UTERUS. Norris, Henry J.; Taylor, Herbert B. (Armed Forces Inst. of Pathology, Washington, D. C.). Obstet. Gynecol., 26: 689-94(Nov. 1965).

The clinical and pathologic findings are presented for 17 patients with sarcomas of the uterus developing after irradiation of the pelvic organs. The evidence relating to the induction of pelvic cancer by radiation in humans is discussed. (TCO)

8791 THE THERAPEUTIC USE OF β-RADIATION IN DERMATOLOGY: RADIOBIOLOGICAL OBSERVATIONS AND GENERAL CLINICAL INDICATIONS. PRELIMINARY RESULTS WITH β-EMITTING RADIOSTRONTIUM AND RADIOYTTRIUM PREPARATIONS. Lovera, G. (Istituto di Dermatologia Univ., Turin). Panminerva Med., 6: 110-14(Apr. 1964).

The physical characteristics of β radiation of ^{90}Sr–^{90}Y sources are discussed with reference to the advantages of this low-penetrating radiation in treatment of skin diseases. The recommended applicator consists of 4 discs filled with radiostrontium. Each platelet is 12 mm in diameter and contains 50 mC of radiostrontium. The back and side walls are made of steel of sufficient thickness to stop radioyttrium β radiation. In this way the β rays can only emerge from the lower surface which faces the skin and consists of a thin sheet (0.3 mm thick) of nickel steel. For the irradiation of small fields the discs are used singly and held in contact with the field to be treated. In the treatment of extensive lesions a special support is used, on which the 4 discs are placed in line, surrounded by a thin curved layer of Plexiglas which enables the preparation to be placed over the lesions. The radiation obtained from the preparations described above is of extremely high intensity. Recorded values of 3140 R/min for contact applicators and 1500 R/min for slide applicators were obtained. At a depth of 5.2 mm the dose is reduced to one hundredth of source strength, while at a depth of 8 mm no appreciable ionization was recorded. These preparations are useful when it is necessary to irradiate lesions situated in thin skin overlying delicate structures which must be spared from irradiation. They are therefore indicated in the treatment of lesions of the eyelids, nostrils, lips and, in very young children, the mandible cartilage. Radiostrontium or radioyttrium β radiations cannot be used in the treatment of malignant lesions, such as squamous cell epitheliomas and other conditions in which deep tumor tissue is suspected. The main indications for β radiation therapy with radiostrontium or radioyttrium sources are listed. (BBB)

8792 MANAGEMENT OF THE COMPLICATIONS OF RADIATION TREATMENT OF BENIGN CONDITIONS. Griffith, B. Herold (Northwestern Univ. Medical School, Chicago). Plast. Reconstr. Surg., 36: 207-17(Aug. 1965).

Technics used and results obtained in the treatment of radiodermatitis are presented. Fifty patients were seen because of complaints which were referable to changes in the skin resulting from prior radiation therapy of a variety of benign conditions. There were a total of 78 lesions. Almost all of these patients had been given radiotherapy for benign conditions by physicians who were not radiologists. In most cases, it was impossible to ascertain the total dose of radiation that had been used. Women outnumbered men about 2:1. Forty-eight percent of the patients had a total of 35 radiation-induced carcinomas, 86% of which were of the basal cell type. Eighty percent of patients who had received radiotherapy for acne developed carcinomas. The average latent period between radiotherapy and appearance of complications was 17.7 years for the patients with carcinoma and 13.7 years for those with benign lesions. The plastic surgical treatment, which is described and illustrated, consisted of total excision of the damaged skin and repair of the defect by simple suture, free skin grafts, or local or distant pedicle flaps, as required. The principles of treatment of radiation injury which have been proposed previously were followed as much as possible. The damaged area should be totally excised and the defect thus created repaired by whatever means seems to be best in the individual case. Local tissue is preferred when it is adequate in amount and can be shifted easily. When tissue must be

brought in from a distance, free grafts are satisfactory if there is a good base on which to place them. For the face, whole-thickness grafts from nearby areas are preferred. They were used successfully in 5 patients with radiation carcinomas and in 4 patients with benign lesions. When larger pieces of skin are needed, thick split-thickness skin grafts afford good coverage. Pedicle flaps are essential when: (1) the base is poorly vascularized; (2) bone, tendon, or a joint is exposed; (3) bulk is needed; (4) surgery on the deeper tissues will be required later; or (5) the defect extends into a cavity. Single-stage procedures are best, when possible. Pedicle tissue from a distance is used only when local tissue is insufficient. (BBB)

8793 THE USE OF BONE MARROW GRAFTS IN THE TREATMENT OF LEUKEMIA. Mathe, G.; Schwarzenberg, L.; Amiel, J.-L.; Cattan, A.; Schneider, M.; Lapeyraque, F. (Hopital Paul-Brousse, Villejuif, France). Presse Med., 73: 1043-6(Apr. 10, 1965). (In French).

F_1 ($C_{57}Bl_6 \times DBA_2$) mice each received 10,000 cells of the leukemia type L 1210. Untreated mice died within ten days of leukemia. Another group of the same strain (which also received 10,000 cells) underwent total-body x irradiation with 800 R, followed by a graft of bone marrow from $C_{57}Bl$ mice. Some were cured of their leukemias (percentage not stated). This technique of adoptive immunotherapy was also used against viral leukemia. Total-body irradiation is a requisite for successful bone grafts. A 200-kv x-ray machine is sufficient for the homogeneous irradiation of mice, but humans are usually irradiated from two sources, simultaneously, with higher energy radiation such as from ^{60}Co. After irradiation, mice are injected with about 2.5×10^7 hematopoietic cells and humans, with 3×10^{10} cells intravenously. The mice are put in individual cages and maintained free of pathogens. Humans are kept in aseptic rooms. After irradiation, the white blood cell count falls. If the graft does not take, the count remains low and the patient dies. If the graft takes, the white blood cell count returns to normal in one to two months. One proof of the graft take is the patient's specific tolerance to donor tissue in the chimeric state. A hematopoietic chimeric patient was grafted with fragments of his own skin and the skin of six others (including the bone marrow donor). He tolerated only his own skin and that of the donor. (BBB)

8794 TREATMENT OF PITUITARY TUMORS BY EXTERNAL IRRADIATION. Fleming, J. A. C. (St. Thomas's Hospital, London). Proc. Roy. Soc. Med., 58: 474-5(July 1965).

Dose considerations and complications resulting from the treatment of pituitary tumors in 40 patients are reported. Both 250-kv x rays and ^{60}Co γ rays were used. Evidence suggesting that the γ rays exert superior biological effects upon these tumors is lacking. Greater physical penetration of γ rays through tissue with much reduced skin damage did enable an adequate tumor dose to be delivered through only three skin fields, resulting in increased accuracy, negligible skin reaction, and less disturbance to the patient. Pituitary adenomata were treated by orthovoltage x rays to total average tumor doses of about 4000–5000 rad given in 20 fractions over about 28 days, without any evident complications. Later, this dose was limited to 4200 rad. Radiation injury, with impairment of vision, is described in one patient given a tumor-dose of 4300 rad with γ rays in 12 fractions. Most cases of pituitary tumor given radiotherapy were chromophobe adenomata. Irradiation of these tumors after surgery significantly increases the control rate, suggesting that combined attack is still preferred to surgery alone. (TCO)

8795 ADVANTAGES OF BETA THERAPY IN OPHTHALMOLOGICAL RADIOLOGY. Vollmar, R.; Lommatzsch, P.; Hegewald, H. (Humboldt-Univ., Berlin). Radiobiol. Radiotherap., 5: 575-83(1964). (In German).

Treatment of ophthalmological disorders with β applicators is far superior to treatment with γ applicators used in the past. The latter often resulted in irradiation complications which produced loss of vision. In the last 10 yr β therapy has markedly influenced radiological treatment of tumors of the eye. Irradiation doses as high as 15,000 to 20,000 rad can be administered without injury to surrounding tissues. Irradiation of the anterior portions of the eye with ^{90}Sr for treatment of melanomas or carcinomas, nevic melanosis, Bowen's dermatosis, keratitis, etc., gives good results. Irradiation is also effective for intraocular tumors. However, the therapy of choice for intraocular tumors often is enucleation because these tumors are relatively insensitive to irradiation. Nevertheless, if there is a possibility of retaining some vision in the affected eye, irradiation treatment should be carried out. Geometric relations for β irradiation of connective tissue tumors and intraocular tumors with ^{90}Sr are given. (BBB)

8796 MASS RADIOGRAPHY DOSAGE. Munro, D. (Mass Radiography Centre, Edinburgh). Radiography, 31: 148-9(July 1965).

Concern is expressed toward the radiation dose patients receive when attending a portable radiography unit for a chest x ray. The dose is more in a portable x-ray unit than on a hospital unit for chest radiography, and certain groups, such as expectant mothers should not attend such an x-ray unit. One way that the portable x-ray unit can reduce the dose to an amount equivalent to that given by a hospital apparatus for chest radiography is described. That is by use of the Bouwers mirror optical system with a small light intensifier tube which has a high amplifying factor and a 70 mm or 100 mm camera. Part of the existing apparatus in a portable radiography unit, that is, the high tension transformers, x-ray tube, and control table, could be used. A new tunnel would be fitted with the Bouwers mirror optical system, and a 70 mm or 100 mm camera, a card index system for registering the number on the films and a high-grain intensifier, would be used. The intensifier provides that the luminosity increases between the fluorescent screen and the photocathode of the intensifier to an amplification factor of 500-3000 times, but when an absorbing object is interposed the intensification is less. There is a further reduction due to mirror and lenses, and the final amplification may be 300 to 400. This final brightness would be obtained with a low milliamperage, which would reduce the skin dose. If such an apparatus were adopted, an experimental set could be given trial tests for six months in a mobile van and six months as a static unit. Any improvements required could be fitted or any new idea incorporated. The U.K. regulations (Ministry of Health Radiological Hazards to Patients, 1960) states that a male patient will receive a mean skin dose of 480 mR on a 100 mm portable radiography unit with 1-mm aluminum filter on the x-ray tube. (With a 2-mm filter the dose would be about 300 mR.) By using the same unit and incorporating the modifications, the dose can be reduced to about 30 mR, which is about the same dose as if a large film had been taken of the chest at a clinic. (BBB)

8797 CURRENT STATUS OF GYNECOLOGICAL X-RAY DIAGNOSIS. (GENERAL REVIEW). Fochem, K. (Univ.-Frauenklinik, Vienna). Radiol. Austr., 15: 7-39 (1964). (In German).

The value and use of x-ray diagnosis in various phases of obstetrics is reviewed in some detail. Mammography is an excellent method for early x-ray diagnosis of pregnancy. A normal mammogram is a sure indication for excluding the possibility of pregnancy during the very early period of gestation. X-ray examination of the fetus during the second half of pregnancy is useful for determining the fetal position, the size of the fetus in relation to the term of pregnancy, the developmental stage of the fetus, viability of the fetus, intrauterine malformations of the fetus, and differential diagnosis of tumors. The relative values of direct and indirect placentography are discussed briefly. Measurement of pelvic dimensions and characterization of several physiological pelvic types are reviewed. Pelvic contours that are considered pathological are discussed, and techniques and standardized procedures for pelvimetric measurements are discussed

and illustrated. Pre- and postpartum injuries to the symphysis are summarized briefly. Studies of the newborn by x ray include evaluation of growth, various birth defects, disturbances of fetal development, and congenital luetic bone defects. The question whether x-ray diagnostic procedures can induce significant irradiation injuries in the fetus is discussed. It is concluded that x-ray photographs should not be made before the end of the fifth lunar month of pregnancy, and not more than one or two photographs should be taken during the second half of pregnancy. Irradiation dose should be minimized by use of higher voltages, lower currents, improved films, and use of an image intensifier. Obstetrical x-ray diagnosis should be regarded only as the last link in the chain of studies made during pregnancy. (BBB)

8798 DOSIMETRY OF ENCLOSED RADIOACTIVE SOURCES OF RADIATION. Minder, W. (Radium-Institut, Bern). Radiologe, 4: 279-86(Aug. 1964). (In German).

Dosimetry of enclosed radioactive sources require measurement of the radiation field and its intensity. Because of the lack of suitable instruments accurately in tissue, it is necessary to make certain assumptions. The dose intensity of the source must be ascertained as accurately as possible under ideal conditions before the results can be used in applied measurements. Isodose curves can be calculated for idealized arrangements of sources, such as for probes containing Ra or for Ra needles. These types of calculations are extremely important for estimations of dosage for gynecological irradiations. In general, the dose, in R/hr perpendicular to the end of the axis of linear radiation sources decreases with the active length of the source. For any given length of the source the dose decreases with increasing distance from the source. The dose falls off rapidly. For β emitters this is especially true, where, because of the wide ranges of energetic particles emitted, only an approximate estimate of the dose can be made. Examples of dose calculation methods for β emitters, the tables of β radiation doses from ^{198}Au, ^{32}P, and ^{90}Y are presented. Dose rates from γ teleradiation units consisting of ^{60}Co, ^{137}Cs, or ^{192}Ir are shown for distances of 50 cm and 1 m. Isodose contour patterns obtained from this type of irradiation unit are illustrated and described briefly. (BBB)

8799 DOSIMETRY OF OPEN RADIOACTIVE SOURCES OF RADIATION. Minder, W. (Radium-Institut, Bern). Radiologe, 4: 286-91(Aug. 1964). (In German).

Open radioactive sources are molecularly dispersed solutions or colloids used for therapeutic irradiation. The dose received from these sources is a function of the average β energy, the effective half life of the radioisotope, and the specific activities of the source. The author provides illustrations of methods used to calculate the internal dose for several radioisotopes used frequently such as ^{24}Na, ^{32}P, ^{35}S, ^{59}Fe, ^{82}Br, ^{131}I, and ^{198}Au. Effects of homogeneously dispersed radioisotopes on dose distribution are discussed and illustrated. As an example of a dose calculation, treatment of the thyroid with ^{131}I is presented. Formulations for calculation of the whole-body dose are shown. The β doses to the skeleton, liver, and other organs after an injection of ^{32}P used for treatment of polycythemia are shown. (BBB)

8800 DIAGNOSTICS OF THYROID DISEASES WITH RADIOIDOINE. Kuhn, H. M. (Univ., Heidelberg). Radiologe, 5: 59-59(Feb. 1965). (In German).

A dose of 50 μC of ^{131}I will result in about 80 rep of irradiation to the thyroid, assuming that 30% is retained with an effective half time of 7 days. The dose to the female gonads from this quantity of ^{131}I amounts to 0.1 rad, and in men the gonad dose is slightly less. If ^{132}I with a half life of 2.3 hr is given under the same conditions the dose is from $1/25$ to $1/100$ of these values. Although the half life of ^{125}I is rather long compared to that of ^{131}I the irradiation dose to the thyroid is only $1/2$. Radioiodine tests and thyroid scintigraphy are relatively simple to perform and have high specificity for diagnosis of thyroid diseases. The significance of results of thyroid function tests such as ^{131}I uptake, triiodothyronine-binding capacity, thyroid stimulation with thyrotropin, thyroid suppression with thyroxin or triiodothyronine, serum concentration of ^{131}I, and $PB^{131}I$ are discussed. These are useful for diagnosis of hypothyroidism, hyperthyroidism, and thyroiditis. Scintigraphy is very useful for diagnosis of thyroid tumors and hyperplasia. 164 references. (BBB)

8801 RADIOIODINE THERAPY OF THYROID GLAND DISEASES. Scheer, K. E. (Univ., Heidelberg). Radiologe, 5: 63-7(Feb. 1965). (In German).

The most important complication of ^{131}I treatment of hyperthyroidism is hypothyroidism. It has been estimated to follow treatment in 10 to 30% of cases, but is is readily controlled by administration of thyroid hormone. Irradiation thyroiditis is a minor complication, and carcinogenesis from irradiation treatment is probably a problem only in patients under 18 yr of age. The dose of ^{131}I recommended for use may vary from 2 to as much as 10 mC, depending on the thyroid uptake, gland size, and turnover rate of the incorporated ^{131}I. Treatment of thyroid carcinoma is much more difficult because ^{131}I uptake is low. Primary thyroid carcinoma should be treated surgically, and thyroid metastases, if they are papillary or follicular, may take up ^{131}I. As a rule single doses of 100 to 150 mC, administered 3 to 6 months apart as long as there is evidence of metastatic uptake, are given. Even though the metastatic lesions receive a high irradiation dose from the ^{131}I incorporated in them, the surrounding healthy tissues are irradiated very little. Uptake of ^{131}I in adenomatous metastatic tissue can be enhanced after the thyroid tissue has been removed by administration of thyrotropic hormone. About 25% of all thyroid metastases can be made to incorporate ^{131}I or have a primary capacity for ^{131}I uptake. The palliative effect of ^{131}I treatment of thyroid metastases generally lasts for several yr, but these patients usually die of metastases that cannot be made to incorporate ^{131}I. Anaplastic carcinomas rarely respond to ^{131}I treatment. (BBB)

8802 RADIOIODINE TREATMENT OF THE DIFFUSE TOXIC THYROID. Ernst, H.; Haasner, E.; Heilmann, H.-P.; Kunze, H. (Freie Univ., Berlin). Radiologe, 5: 67-70(Feb. 1965). (In German).

Excellent results can be obtained by careful treatment of diffuse toxic goiter with ^{131}I. Compared to treatment with drugs, ^{131}I gives a higher cure rate. After treatment with thyrostatic drugs the remission rate for hyperthyroidism is from 50 to 70%, and after ^{131}I treatment it is 80 to 100%. In addition, drug treatment may induce exophthalmia. The disadvantages of surgical treatment include operational mortality, irreversible lesions of the recurrent laryngeal nerve, permanent hypothyroidism, recurrence of the toxic thyroid, and tetany on account of parathyroid injury. Disadvantages of ^{131}I treatment include a relatively delayed appearance of effect, which may amount to 2 or 3 months, unavoidable irradiation of the gonads, and, in young patients, possible carcinogenic effect. Treatment with ^{131}I should not be carried out in patients under 30 or in pregnant patients. There is no evidence of increased leukemia incidence. Side-effects may include brief exacerbation of thyrotoxic symptoms about 2 or 3 weeks after treatment, and joint inflammation in patients with polyarthritic diseases. (BBB)

8803 A COMPRESSION CONE FOR PELVIC SUPERVOLTAGE IRRADIATION. Leborgne, J.H.; Leborgne, F.; Barlocci, L. A. (Hospital Pereira Rossell, Montevideo). Radiologia (Panama), 15: 9-11(Dec. 1964). (In Spanish).

The construction and application of a cone which is used to compress the pelvis during ^{60}Co therapy of uterine carcinoma are described and illustrated. With this cone it is possible to localize irradiation of the tumor by reducing the irradiated volume, thereby sparing adjacent intestine from the injurious effects of radiation. The cone is designed for use with a 1000-C ^{60}Co source. It permits the pelvic depth irradiated to be reduced by 1.5 to 5.5 cm

(average 3.4 cm). The average anterior-posterior pelvic field is thus reduced to 20.8 cm. Radiographs are illustrated showing how the intestine is thereby displaced from the irradiated field when the compression cone is in place. The cone is constructed of aluminum (collimation of the beam is provided by lead shielding the source) and has a 16 × 16 cm end window with a Perspex frame and cross piece. Results obtained with it in 40 cases of uterine cancer are described. When the apparatus described was used with a total dose of 5500 rad fractionated over 5 weeks, only mild erythema and skin pigmentation were seen. (BBB)

8804 SUITABILITY OF ISOTOPE RENOGRAPHY FOR STUDY OF THE KIDNEY IN PREGNANCY. **Laakso, L.; Rekonen, A.; Holopainen, T. (Univ. of Turku, Finland). Scand. J. Clin. Lab. Invest., 17: 395-7(1965).**

The radiation dose to the fetus during renographic studies of toxemia during pregnancy, using ^{131}I-Hippuran, was determined. For a Hippuran dose of 10 μC the estimated kidney dose is 4 mR, which is about 1% of the radiation dose required in excretion urography. Studies were made on 10 patients on whom therapeutic abortion was performed in the 12 to 14th week of pregnancy. The patient was given 30 μC of Hippuran-^{131}I by intravenous injection an hour before caesarean section. The total radioactivity of the fetus was measured with a scintillation counter. The result was compared with the pulse rate obtained from a Hippuran dose of 30 μC in the same volume of water. The activity thus found to be transferred to the fetus was less than 0.1% of the dose administered. After the positive results obtained from these tests, the examination was conducted on a parturient group (11 patients). These patients were given 10 μC of Hippuran-^{131}I by intravenous injection during delivery. After delivery, samples were taken of umbilical cord blood, infant's urine, amniotic fluid, and placenta. The radioactivity of these samples was measured in a well counter. The absolute value was obtained by comparing the activity with that of a sample of 10 μC. The following activity ranges were obtained: umbilical cord blood 0.1-0.2 μC/l, infant's urine 0.1-0.2 μC/hr, amniotic fluid—no activity, and placenta 0.1-1.0 μC/kg. The time from injection to delivery varied from 10 min to 4 hr. The calculations made on the basis of the activity values gave the following upper limits: infant's gonadal dose < 0.5 mR and infant's kidney dose < 2 mR. Comparison of these gonadal and renal doses of 0.5-2 mR received by the infant with the dose to the fetus in pelvimetric roentgenography (1500 mR) and with natural background radiation exposure (100 mR/year) shows that renography, according to present radiobiologic knowledge, is a harmless examination for the pregnant woman and fetus. (BBB)

8805 A SOLID STATE NEEDLE DETECTOR FOR THE DETERMINATION OF REGIONAL BLOODFLOW IN THE BRAIN AND THE KIDNEY BY THE ^{85}Kr CLEARANCE METHOD. **Appelgren, K. L.; Lewis, D. H.; Haeggendal, E. (Sahlgrenska Sjukhuset, Goteborg, Sweden). Scand. J. Clin. Lab. Invest., 17: 511-12(1965).**

A new type of needle detector for β radiation was developed for use with ^{85}Kr in the determination of the regional blood-flow of an organ by the clearance of the inert gas from the tissue. A small solid state needle detector can be inserted directly into the tissue which is sensitive almost exclusively to β radioactivity from a small area of tissue around the detector. The new detector is a needle-type lithium-drifted p-i-n junction semiconductor detector shaped as a cylinder 0.9 mm in diameter and 2.5 mm long. It is encased in a stainless tube 50 mm long with an OD 1.4 mm except for 10 mm in the free end of the tube where the OD is 1.1 mm, corresponding to a wall thickness of 0.05 mm. The sensing element is placed in the 1.1 mm part of the tube. The free tip of the needle is sealed by No. 1 Hivac epoxy inert to the tissue. The detector is operated with a bias voltage 20–40 v. The signal from the detector is amplified by a low-noise charge-sensitive, preamplifier and recorded via a conventional discriminator unit on a ratemeter-scaler unit. With ^{85}Kr the detector gave a measured ratio of γ to total activity which was 10% of the theoretical ratio which is 0.4%. That is, the detector works practically as a β detector with a good $\beta:\gamma$ ratio for ^{85}Kr. (BBB)

8806 THE MYELOPROLIFERATIVE DISORDERS. **Israels, M. C. G. (Univ. Infirmary, Manchester, Eng.). Scot. Med. J., 10: 225-34(June 1965).**

Various factors in considering the use of radiotherapy (particularly ^{32}P) to treat polycythemia vera are discussed particularly with regard to the late occurrence of leukemia and its possible etiologic relation to radiotherapy. Data from the literature are compiled showing leukemia incidence in patients treated with and without radiotherapy. This survey shows that of 635 patients treated with x rays or ^{32}P, 70 developed acute leukemia. In contrast, only one patient developed acute leukemia of 327 polycythemia patients dying after nonradiation treatment. (TCO)

8807 RADIODERMATITIS: A STUDY OF 60 INDIVIDUAL CASES. **Monfort, J.; Duperrat, B. (Hopital Saint-Louis, Paris). Sem. Hop. Paris, 41: 465-72(Feb. 14, 1965). (In French).**

Thirty-nine women and 21 men with radiodermatitis were studied. The average age of the women was 51 years, and of the men, 46. The periods of latency between irradiation and appearance of radiodermatitis varied greatly. Among the women, in ten cases dermatitis was latent less than one year; in ten cases, between one and five years; and in 16 cases, more than five years (two for 30 years and one for 40). In the men, 11 cases were latent less than one year; three, between one and five years; and three, more than five years. Women seemed to be more sensitive, although they had longer periods of latency. Five of the patients had been irradiated for diagnostic and 55 for therapeutic purposes. The diagnostic group of five had all been exposed for one hr. In the radiotherapeutic group: 25 had had skin tumors; 12, dermatitis; three, cervical lymphadenitis; 12, deep lesions; and three were radiology technicians occupationally exposed. With a few exceptions, the use of radiotherapy in these cases could not be justified. One patient, irradiated for a wart, required amputation 16 years later. The Chaoul contact technic was responsible for seven cases of radiodermatitis and radium for four. In the remainder of the cases, the nature of the radiation was unknown. In 15 cases dermatitis was on the head, 23 on the limbs, four on the neck, and 18 on the trunk. Eleven of the patients complained of sensitivity to the sun, which aggravated their radiodermatitis. In six (10%) of the patients, the radiodermatitis was followed by malignant changes. The blood and lymph vessels had been damaged, causing some of the epidermal alterations observed. (BBB)

8808 UROLOGICAL X-RAY DIAGNOSIS AND RADIATION DOSAGE. **Liess, G. (Humboldt-Univ. Medizinische Fakultaet, Berlin). Z. Urol., 57: 241-9(Apr. 1964). (In German).**

The greatest handicap in radioprotection is that it is not possible to relate an injury to the exposure that may have caused it. For example, a fetal injury such as radioinduced leukemia may first appear only months or years later, and a genetic injury may require generations before it becomes apparent. The order of magnitude at which radiation may cause serious injury to tissues and organs varies considerably. The human embryo may be seriously injured with irradiation at a level of about 1 R; the fetus may be injured with a higher dose of 3 R. For the gonads the dose is about 10 R. The bone marrow and lens of the eye show injury at about 100 R. An acute irradiation of 1000 R may be injurious to skin, but with chronic skin irradiation as much as 10,000 R may be required to produce serious injuries. Gonadal irradiation injury is most pertinent to preservation of the genetic integrity of populations. Its level can be reduced during urological studies in male patients by keeping the testes out of the radiation beam or by a protective Pb shield. In women of child-bearing age, reduction of radiation exposure of the ovaries can be achieved only by precise shielding of the anatomical field. (BBB)

8809 THE PLACE OF GOLD PUNCTURE IN GYNECOLOGICAL ACTINOTHERAPY. Stanicek, J.; Feit, J. (J. E. Purkyne Univ., Brno). Zentralbl. Gynaekol., 86: 1129-35(Aug. 8, 1964).

Gold puncture is the introduction of particles of metallic ^{198}Au into tumor tissue using a pistol-like instrument. The particles are plated with Pt and have an initial activity of from 4 to 6 mC. At a distance of 1 cm from the surface of the particle the dose amounts to 900 to 1000 R. At 0.5 cm it ranges from 3600 to 5000 R, and it is more than 10000 R at the surface of the particle. If the particles are implanted in a tumor at a distance of 1 or 1.5 cm from one another, they produce a relatively homogeneous irradiation field with an intensity of about 7000 to 10000 R. One disadvantage of gold puncture is that the particles cannot be removed once they have been implanted. This method of irradiation was used in 20 patients with carcinoma or papillomatosis of the bladder, pelvic metastases of cervical tumor, metastatic vaginal carcinoma, metastatic ovarian carcinoma, and vulval tumor. The ^{198}Au implantation treatment was administered with and without implantation of Ra. Over a period of 2 yr, with one exception, the tumors showed evidence of regression or were destroyed without development of vaginal fistulas. (BBB)

8810 PUBLIC HEALTH AND THE MEDICAL USE OF IONIZING RADIATION: FIFTH REPORT OF THE WHO EXPERT COMMITTEE ON RADIATION. Faber, M. World Health Org. Tech. Rep. Ser., No. 306, 41p(1965).

The present status of protective practices of the use of ionizing radiation in medical diagnosis and treatment are assessed. An appendix provides 74 recommendations for improving technique while lowering patient and personnel exposure. The possible somatic and genetic risks associated with the doses at present delivered during radiodiagnosis and radiotherapy were considered, but were estimated to be small, provided that radiological procedures were carried out with the indicated precautions. The responsibility of the public health authorities for giving due attention to the benefits and risks of the medical use of ionizing radiation and for taking all measures required to obtain the maximum benefit with the minimum of risk is discussed. Education and research were concluded to be essential elements in achieving the best use of ionizing radiation for medical purposes. Among specific recommendations proposed, it is emphasized that fluoroscopy should not be used as a substitute for radiography. (TCO)

CHEMISTRY

General

Refer also to abstracts 9597, 9606, and 10439.

8811 (COO–1248–4) THE ELECTRICAL CHARGING OF SMALL PARTICLES AT LOW PRESSURES. Third Progress Report, September 15, 1964 - September 15, 1965. Liu, B. Y. H. (Minnesota Univ., Minneapolis. Particle Technology Lab.). Oct. 1965. Contract AT(11-1)-1248. 80p. Dep. mn. CFSTI $3.00 cy; $0.75 mn.

The electric charge imparted to aerosol particles ranging in size from 0.08μ to approximately 3μ was measured experimentally in a combined charger and mobility analyzer over the pressure range from 0.01 to 0.001 atmosphere. Solid spherical particles of methylene blue dye were used in these studies and they were charged under electric field intensities of 100 and 240 volts/cm by positive ions produced in a corona discharge. The product of ion concentration and charging time used in the experiments ranged to a maximum value of 3.0×10^6 (ions/cc)(sec). The measured charge on particles was compared with values predicted by various theories and the results indicate that both the diffusion and field charging equations underestimate the particle charge by a factor ranging from approximately 2 to 30. (M.O.W.)

8812 (ORNL–3830) CHEMICAL TECHNOLOGY DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING MAY 31, 1965. (Oak Ridge National Lab., Tenn.). Nov. 1965. Contract W-7405-eng-26. 326p. Dep. mn; CFSTI $7.00 cy, $1.50 mn.

Research and development are reported in eighteen sections. Separate abstracts were prepared for all sections. (J.R.D.)

For abstracts of individual sections see: 8834, 8885, 8982, 9044–9055, 9093, 10438, and 10439.

8813 GENIE ATOMIQUE. TOME V. ELABORATION DES MATERIAUX NUCLEAIRES DE BASE. ELABORATION ET UTILISATION DES ELEMENTS ARTIFICIELS. Deuxieme Edition Revue et Augmentee de Partie du Tome IV. (Atomic Engineering. Volume V. Production of Basic Nuclear Materials. Production and Utilization of Artificial Elements. Second Edition Review and Addenda to Part of Volume IV). Saclay, France, Institut National des Sciences et Techniques Nucleaires. Paris, Presses Universitaires, 1965. 596p.

A series of monographs on the production and use of basic nuclear materials and artificial elements was compiled. The topics considered are the preparation of uranium from the ore to the ingot, the preparation of thorium from the ore to the metal, the formation and properties of transuranium elements and fission products, chemical properties of plutonium, chemical processing of irradiated fuel elements, the physical and chemical properties of isotopes, separation of isotopes, production of heavy water, separation of uranium isotopes, electromagnetic separation of isotopes, isotopic analysis and determination of heavy water and uranium, production of graphite for nuclear purposes, preparation of radioisotopes, industrial uses of radioisotopes, biological tracers, and the chemical uses of radiation. Each section contains its own bibliography and there is an index for the entire volume. (J.S.R.)

Analytical Procedures

See also Separation Processes and Procedures

Refer also to abstracts 9169, 9183, and 9249.

8814 (AAEC/E–141) THE RECOVERY OF BERYLLIUM FROM BERYLLIUM OXIDE MATRIX FUELS THROUGH ITS OXYACETATE. Farrell, M. S.; Szego, L.; Yates, P. B. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). July 1965. 16p. Dep. mn.

The laboratory development of a process for the recovery and decontamination of beryllium from fuel processing solutions is described. Azeotropic distillation is used in converting aqueous beryllium solutions to beryllium oxyacetate. The beryllium oxyacetate is then purified by recrystallization. Using a feed solution containing 3 β-Curies of fission products per mole of beryllium, a decontamination factor of 3 to 4×10^3 can be obtained with a 90% recovery of beryllium. Some solubility and conductance data are given for beryllium oxyacetate and its hydrolysis products. The hydrolysis reaction is briefly discussed. (auth)

8815 (AE–204) NEUTRON-ACTIVATION ANALYSIS OF NATURAL WATER APPLIED TO HYDROGEOLOGY. Landstroem, O.; Wenner, C. G. (Aktiebolaget Atomenergi, Stockholm (Sweden)). Dec. 1965. 28p. Dep. mn.

The natural content of elements in water was utilized to characterize different ground water supplies and reveal the presence of ground water streams. A neutron activation method including chemical group separation techniques was used for the determination of trace elements. Analyzed water samples from three different places in northern Sweden illustrate the application to common and important hydrogeological problems, such as the quality and capacity of water supplies, the origin and existence of ground water streams, and ground water exchange with rivers. (auth)

8816 (APDA–178, pp 30-42) SODIUM TECHNOLOGY LOOP. Meyers, J. E. (Atomic Power Development Associates, Inc., Detroit, Mich.).

An investigation of the response of the Rhometers and oxygen meters to sodium monoxide injections in the sodium loop was made. Some results from this investigation are presented. A study was undertaken to design a high-speed centrifuge for processing sodium on a continuous-flow basis in the sodium technology loop. The problems involved in adapting a conventional centrifuge to sodium service were reviewed. Results from hydrogen solubility studies in sodium are presented. (M.O.W.)

8817 (BNWL–36, pp 4.1-77) CHEMICAL EFFLUENTS TECHNOLOGY. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Research on soil chemistry and geochemistry, soil physics, and atmospheric radioactivity and fallout and aerosols is reported. Twenty articles or abstracts are included. (P.C.H.)

8818 (BNWL–159) DETERMINATION OF ^{232}U AND ^{233}U IN IRRADIATED THORIUM. Weiler, M. R.; Matsumoto, W. Y. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Nov. 1965. Contract AT(45-1)-1830. 24p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Analytical methods of dissolution, separation, and measurement for the determination of uranium in irradiated thorium were developed. The detailed procedures are appended. Uranium recovery is about 93% by anion exchange and about 97% by amine extraction. Decontamination factors are of the order of 10^6 for thorium and most fission products and 10^4 for protactinium, zirconium, and niobium. ^{233}U is measured by two techniques. Natural uranium is added as an isotopic diluent prior to sample dissolution and the $^{233}U/^{238}U$ atom ratio of the purified fraction is measured with a thermal emission mass spectrometer. A second measurement is obtained by total alpha counting in a gas-flow proportional counter and subsequently correcting for chemical yield and for alpha contributions of ^{232}U and ^{234}U. ^{232}U is determined by alpha energy analysis using a silicon surface barrier

detector and a multichannel pulse height analyzer. As little as 0.2 part ^{232}U per million parts ^{233}U can be measured. (P.C.H.)

8819 (CEA-Bib-62) IDENTIFICATION DES RADIOELEMENTS PAR LEUR RADIOACTIVITE. (Identification of Radioelements According to Their Radioactivity). Prospert, Jacques (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Nov. 1965. 27p. Dep. mn.

Studies showed that the identification of radioelements based on radioactivity is possible due to a great variety of techniques. In the presence of an unknown radioelement, it is necessary first of all to determine the nature of the radiation emitted; this is easily done using an absorption method for example. When this has been established, it is possible to complete the identification of the radioelement using its period or its energy, or even using a combination of these two measurements when one alone is not sufficient. Normal half life measurement techniques make it possible to determine this parameter for values of from a few seconds to several years. The energy measurements are usually carried out by absorption or spectrometry. 53 references are cited. (auth)

8820 (CEA-R-2742) CONTRIBUTION A L'ETUDE DU MECANISME DE L'EXTRACTION DU CHLORURE D'URANYLE PAR LES AMINES ALIPHATIQUES A LONGUES CHAINES [THESES]. (Contribution to the Study of the Mechanism of Extraction of Uranyl Chloride by Long Chain Aliphatic Amines [Thesis]). Rubinstein, Georges R. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1965. 79p. Dep. mn.

Submitted to Paris Univ., France.

The structure of the organic complex of uranyl chloride was defined on the basis of the study of the variation of the distribution coefficient of uranium between the two phases at the equilibrium as a successive function of the activity of Cl^- ions in the aqueous phase, the concentration of amine salt in the organic phase, and finally of the concentration of uranium in the aqueous phase. The following formula is proposed for the extracted compound: $UO_2Cl_4^{2-}(NR_3H^+)_2$. Calculation of the equilibrium constant of formation of the organic compound of uranyl chloride was possible in the case of dilute solutions of uranium only. (P.C.H.)

8821 (CONF-727, pp 25-31) POLONIUM URINALYSIS PROCEDURE. Sheehan, W. E. (Mound Lab., Miamisburg, Ohio).

The urinalysis procedure for the determination of polonium, which was used for 16 years, was revised. Although the efficiency of each procedure was the same, the count level of the modified procedure was four times greater. (auth)

8822 (CONF-727, pp 155-60) THE USE OF COULOMETRY IN ROUTINE ANALYSIS. Duffy, Thomas L.; Ferguson, Byron L. (Argonne National Lab., Ill.).

Applications of coulometry in industrial hygiene analysis and progress made in developing new procedures for coulometry are reported. Advantages in using coulometric techniques include: standardization by current instead of standard solutions; limitation of detection primarily by the current available and the sensitivity of the detection system; and extremely good accuracy and precision. Using a constant current source (Sargent Model IV) the following systems are discussed; determination of acids and bases; use of halogens as titrants; and complexometric titrations. (H.G.D.)

8823 (CONF-727, pp 171-3) THE DETERMINATION OF ^{235}U BY PULSE HEIGHT ANALYSES. Hoover, Reynold L.; Hancock, Robert L. (Combustion Engineering, Inc., Windsor, Conn.).

The equipment and procedure used for detection and counting of ^{235}U in >.01 mg amounts are described. Amounts of this magnitude may be detected by gamma scintillation counting on the .184 Mev peak of a pulse height analyzer. The technique requires that solid or liquid samples be placed in 4 ml vials and gamma counted in a NaI well-type crystal. The counts are thin compared to a ^{235}U standard counted in the same manner. (H.G.D.)

8824 (CONF-727, pp 174-8) THE SIMULTANEOUS DETERMINATION OF CALCIUM, STRONTIUM AND BARIUM IN BONE ASH BY RADIOCHROMATOGRAPHY. Welford, George A.; Morse, Robert S.; Chiotis, Elias L. (Health and Safety Lab., New York Operations Office (AEC), N. Y.).

Strontium, barium, and calcium were separated from each other and from microgram quantities of bone on a paper chromatogram. After separation, the elements were precipitated and tagged by a precipitant ($H_2{}^{35}SO_4$) that was migrated along the chromatogram by a suitable solvent. The solvent moved the precipitant to the end of the chromatogram so that the precipitant did not interfere with analysis of the element. A good separation of Sr, Ca, and Ba was indicated where 5 and 10 ml (equivalent to 50 and 100 micrograms of bone) of the bone were used. (H.G.D.)

8825 (CONF-650620, pp 271-5) THE LIQUID METAL OXYGEN METER. Minushkin, B. (United Nuclear Corp., White Plains, N. Y. Development Div.). (UNC-MTL-4734).

An on-line instrument for continuously monitoring the effective oxygen content in sodium was developed. The meter is rugged and suitable for use in sodium systems under field conditions. It is specific for oxygen, and useful at low oxygen levels in the range from 1 to 100 ppm. It is extremely sensitive to small changes in oxygen concentration, particularly at low levels. Its response to changes in oxygen content is rapid, it is relatively insensitive to changes in sodium temperature, and it is independent of sodium velocity over reasonably large ranges. (auth)

8826 (CONF-650902-27) SEPARATION OF INORGANIC IONS ON INORGANIC COMPOUNDS. Rein, James E. (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). [1965]. Contract AT(10-1)-205. 18p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From American Chemical Society, 150th National Meeting, Atlantic City.

The separation of inorganic ions with inorganic compound exchangers was surveyed with emphasis placed on describing the mechanisms of exchange for the various classes of compounds and citing examples for application to analytical chemistry. The ion exchangers discussed include: micaceous minerals; clay minerals; zeolites, hydrous oxides; heteropoly acid salts; and insoluble salts. (P.C.H.)

8827 (GA-6152) USE OF NEUTRON ACTIVATION ANALYSIS IN SCIENTIFIC CRIME DETECTION. 12-Month Summary Report for the Period November 1, 1963-October 31, 1964. Bryan, D. E.; Guinn, V. P. (General Atomic, San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science). Feb. 15, 1965. Contract AT(04-3)-167. 59p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

Studies of the deposition of gunshot residues on the hands and face of a person firing a rifle were initiated. The results showed that Ba and Sb traces are deposited on the hands and face when this rifle is fired. Work on the feasibility of tagging gunpowder with trace amounts of elements especially suitable for detection by neutron activation analysis gave results that were quite promising. A method of showing the comparison of samples in a manner that is easily visualized by nonscientists, such as members of a jury, was also developed. The method involves the comparison of gamma spectra of activated samples by plotting the normalized spectra of two or more samples on the same graph paper. Problems involved in the analysis of hair by neutron activation are discussed. Results on the analysis of paints, paper, and skin are also given. (P.C.H.)

8828 (K-1638) DETERMINATION OF METALLIC IMPURITIES IN ALUMINUM BY X-RAY FLUORESCENCE. Kienberger, C. A.; Flynn, A. R. (Oak Ridge Gaseous Diffusion Plant, Tenn.). Jan. 14, 1966. Contract W-7405-eng-26. 19p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

An x-ray fluorescence method was developed for process control measurement of uranium in aluminum being decontaminated in a salt bath furnace, and for determining uranium, magnesium, silicon, barium, chromium, manganese, iron, nickel, copper, and zinc in the cast aluminum ingots. Homogeneous samples were obtained by pouring the molten aluminum into a special mold to form a flat disk. Uranium concentrations as low as 2 ppM in aluminum can be detected. Relative standard deviations of ±5% were obtained for single measurements of uranium at the 200 ppM level, magnesium at the 2% level, and the other metallic impurities at concentrations of 0.5%. A determination of any one of the above ten elements can be made in less than 10 minutes. (auth)

8829 (LF–28, pp 13-17) A METHOD FOR ASSAY OF HIGH LEVEL ^{90}Sr BY THE BREMMSTRALUNG SPECTRUM. Newton, G. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.).

A procedure for the assay of high level samples of ^{90}Sr by bremsstrahlung spectrum is described. The bremsstrahlung counts were made on a 3 × 3 in. NaI crystal connected to a multi-channel pulse height analyzer, a liquid scintillation well-type detector scaler, and on the opposed crystal small animal whole-body counter. Cross checks of the calibration of the reference sources agreed within ±5%. (P.C.H.)

8830 (LF–28, pp 40-3) URANYL NITRATE-MONTMORILLONITE CLAY EXCHANGE. Posner, S.; Bennick, J. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.).

The possibility of exchanging uranyl ions with clay particles was investigated. A 1.0% by weight solution of uranyl nitrate (45% enriched) was exchanged with 12.5 mg of 0.05-μ clay particles. After encapsulation, washing, and drying, the particles were irradiated for 12 hr. The amount of uranyl ion exchange with the clay was calculated by determining the ^{140}La and subsequent determination of ^{140}Ba. Preliminary results indicated an uptake of uranyl ion by clay of 26%. (P.C.H.)

8831 (NP–15634) A COMPARISON OF NEUTRON ACTIVATION ANALYSIS AND VACUUM FUSION ANALYSIS OF THE OXYGEN CONTENT OF STEEL. Pasztor, L. C. (Jones and Laughlin Steel Corp., Pittsburgh, Pa.); Wood, D. E. (Kaman Nuclear, Colorado Springs, Colo.). [1965]. 36p.

A system developed for the fast-neutron activation analysis of the oxygen content in metals was tested comparatively with the more conventional vacuum fusion techniques. The results indicate that neutron activation analysis is much faster (the total analysis takes only 2 minutes or less), and more reliable than vacuum fusion methods since all oxygen present is analyzed. Samples can be much larger than the 0.2–3 gram samples used for the fusion method. Furthermore, the analysis is nondestructive—the same samples can be re-analyzed as often as desired. The standard deviation in the neutron activation analysis tests was approximately 3%, whereas a deviation of only 1% can be achieved in more refined systems. The neutron activation method and facilities are described. (P.C.H.)

8832 (NP–15780) ACTIVATION ANALYSIS WITH A NEUTRON GENERATOR. Dibbs, Hugh P. (Department of Mines and Technical Surveys (Canada). Mines Branch). Feb. 1965. 91p. (R–155). Dept. of Mines and Technical Surveys, Ottawa $1.25.

An account is given of an activation analysis system using a neutron generator as a neutron source. The shielding requirements for high-energy neutrons and the experimental irradiation facilities are described. Activation yields were calculated, under defined conditions, for all stable nuclides that on irradiation with 14 Mev neutrons or with thermal neutrons produce gamma-emitting isotopes. Experimental measurements were also made to determine the sensitivity of detection of sixty-six elements. The gamma spectra resulting from a number of these empirical determinations are presented. (auth)

8833 (NYO–3369-6) ISOTOPIC ABUNDANCE STUDIES BY NEUTRON ACTIVATION ANALYSIS. Annual Report, April 15, 1964–April 14, 1966. Corless, James T. (Rhode Island Univ., Kingston. Graduate School of Oceanography). Contract AT(30-1)-3369. 14p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

A sensitive and reliable technique based on neutron activation analysis was developed for the determination of variations in the relative abundance of ^{48}Ca in nature. It was also found that measurable variations in the relative abundance of ^{48}Ca do exist. (P.C.H.)

8834 (ORNL–3830, pp 236-47) HIGH-TEMPERATURE CHEMISTRY. (Oak Ridge National Lab., Tenn.).

Activities in a program to develop spectrophotometric techniques for studying the properties of aqueous solutions are summarized. Emphasis is placed on equipment and techniques for solutions containing U, transuranic elements, rare earths, and transition elements. Information is included on high-pressure-temperature spectrophotometer development, spectra of ionic systems, factors affecting uranyl ion spectra, liquid densities at high pressure and temperature, computer programs for spectrometry, spectral band models and profiles, and smoothing of digitized spectral data. (J.R.D.)

8835 (RFP–414) ANALYSIS OF AMERICIUM FOR PLUTONIUM, THORIUM AND RARE EARTH IMPURITIES BY EMISSION SPECTROSCOPY. Barton, H. N. (Rocky Flats Div., Dow Chemical Co., Golden, Colo.). Oct. 27, 1965. Contract AT(29-1)-1106. 25p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

Parts per million impurity concentrations of plutonium, thorium, and rare earth elements in americium were determined by an optical emission spectrographic method after their separation by ion exchange. Plutonium and thorium were separated by adsorption of their nitrate complexes on an anion exchange column and determined by a photometric procedure. Rare earths were separated by a thiocyanate anion exchange column and determined by visual comparison with standard spectra. (auth)

8836 (TID–22511(Suppl.)) IMPROVED ALUMINO SILICATE ION EXCHANGERS. Calmon, C.; Grundner, W. T. (Ionac Chemical Co., Birmingham, N. J.). Nov. 1962. Contract W-7405-eng-26, Subcontract No. 2193. 23p. (IONAC–5002(Suppl.)). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

For Oak Ridge National Lab., Tenn.

A number of the alumino-silicate ion exchangers were analyzed to establish the true ratio of their components. Ion-exchange properties in regard to strontium were determined for certain selected gels. (P.C.H.)

8837 (UCRL–12201) THE DETERMINATION OF TRACE CARBON IN METALS BY NONAQUEOUS TITRATION. Boyle, Walter G. Jr.; Stephens, Frederick B.; Sunderland, William (Lawrence Radiation Lab., Univ. of California, Livermore). Nov. 30, 1964. Contract W-7405-eng-48. 18p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

A nonaqueous titrimetric procedure is described for determining the carbon dioxide evolved from metal samples which were combusted in oxygen in an induction furnace. The carbon dioxide is titrated continuously using sodium hydroxide in pyridine as a titrant, acetone as the solvent, and thymol blue as the indicator. An independent standardization procedure is described and results are given showing the sensitivity, precision, and accuracy of the determination. (auth)

8838 (UCRL–14258) RADIOCHEMICAL PURIFICATION PROCEDURES FOR THE ELEMENTS. Lindner, Manfred (comp.) (Lawrence Radiation Lab., Univ. of California, Livermore). July 13, 1965. Contract W-7405-eng-48. 102p. Dep. mn. CFSTI $4.00 cy, $1.00 mn.

Radiochemical procedures, developed by various experimenters at the Lawrence Radiation Laboratory in Livermore, are described for the purification of 48 individual elements from complex mixtures of radioactive species,

preponderantly fission products. The degree of purification and the time required to perform the separations are given. (auth)

8839 X FLUORESCENCE AND THE RADIOMETRIC METHODS OF INDUSTRIAL ANALYSIS USING ISOTOPIC SOURCES. Broquet, C. Bull. Inform. A. T. E. N. (Ass. Tech. Energ. Nucl.), No. 55 Suppl., 4-9(Sept.-Oct. 1965). (In French).

The physical principles used by devices for radiometric analysis are described. The technological methods used and their application are considered. The uses of radioactive gages are also considered. (J.S.R.)

8840 ON THE POSSIBILITIES OF THE NONDESTRUCTIVE DETERMINATION OF FLUORINE BY NEUTRON ACTIVATION AND GAMMA SPECTROMETRY OF ^{20}F OR OF ^{16}N (HALF LIVES 10.7 AND 7.35 sec RESPECTIVELY). COMPARATIVE STUDY, APPLICATION TO CRYOLITE. Haerdi, W.; Voldet, P.; Monnier, D. (Univ., Geneva). Helv. Chim. Acta, 48: 1776-81(Oct. 30, 1965). (In German).

A nondestructive method for the determination of fluorine, based on the reaction $^{19}F(n,\alpha)^{16}N$ (half life of ^{16}N = 7.35 sec) resulting from the activation of fluorine with fast neutrons, was developed. With a thermal neutron flux of 2.5×10^9 n cm^{-2} sec^{-1}, a decay time of 10 sec, and a counting time of 6 sec, approximately 5 mg could be determined; this limit was fixed at 0.5 μg if the flux was 10^4 larger. If the nuclear reaction $^{19}F(n,\gamma)^{20}F$ (half life of ^{20}F = 10.7 sec) occurs, the determination limit is 10 mg. The concentrations found on the various cryolite samples by the ^{16}N method corresponded to those obtained by spectrometry after separation of the fluorine by distillation. (tr-auth)

8841 METHOD FOR DETERMINATION OF THE SPECIFIC RADIOACTIVITY OF C ATOMS OF CARBOXYLIC ACID BY THE SCHMIDT DEGRADATION. Brenner-Holzach, O.; Leuthardt, F. (Univ., Zurich). Helv. Chim. Acta, 48: 1804-5(Oct. 30, 1965). (In German).

A method for the determination of the specific radioactivity of carbon atoms is reported. The CO_2 produced by the Schmidt degradation process was captured in 0.5N caustic lye solution. The CO_2 was determined manometrically in an aliquot. Another aliquot was introduced into a Conway scale and absorbed by cyclohexylamine. The cyclohexylamine was introduced directly to the scintillation mixture. The results obtained for acetate-1-^{14}C, acetate-2-^{14}C and acetic acid-1-^{14}C were tabulated as examples of the degradation method. (J.S.R.)

8842 ELECTRON BOMBARDMENT ION SOURCE FOR ISOTOPIC ANALYSIS OF SOLIDS. Tyrrell, A. C.; Roberts, J. W.; Ridley, R. G. (Atomic Weapons Research Establishment, Aldermaston, Eng.). J. Sci. Instrum., 42: 806-7(Nov. 1965).

A compact arrangement is described which allows an electron bombardment crucible source system to be used in thermal ionization solid source mass spectrometers. It is possible to insert the electron producing filament, the ionization chamber and the crucible into existing vacuum locks designed solely for thermal ionization use. Modifications necessary to use this source on an AEI MS 5 mass spectrometer are described together with the minor changes to the existing filament supplies required to stabilize the total electron emission. Memory effects are very low and samples of nickel, tellurium, antimony, copper and cadmium can be isotopically analyzed with less than 5 μg amounts. (auth)

8843 SOME PROBLEMS WITH IN-PILE IRRADIATION FACILITY FOR ACTIVATION ANALYSIS. Csoke, Antal; Peter, Istvan. Magyar Tud. Akad. Kozp. Fiz. Kut. Int. Kozlemen., 13: 343-52(1965). (In Hungarian).

Engineering problems, which had to be faced in the design and building of a rabbit system for fast in-pile, irradiation, are reviewed. In addition, the activation of air acting as carrier gas, the behavior of a "rabbit" made of danamide when exposed to a strong neutron flux, the stability of electronics, and a possible explanation of the phantom phenomenon are discussed. (auth)

8844 THE ELECTRON-BEAM MICROANALYZER AND ITS INFORMATION POSSIBILITIES. Malissa, Hanns (Technische Hochschule, Vienna). Mikrochim. Ichnoanal. Acta, No. 3, 389-94(1965). (In German).

The essential constituents of the electron-beam microanalyzer are described and shown. The combination of the electron-beam microanalyzer with electron microscopy and micro x-ray diffraction measurements is considered. The wide application of the microanalyzer in many fields is briefly indicated. (J.S.R.)

8845 OPERATIONAL METHODS FOR THE PROPORTIONAL COUNTER DETERMINATION OF ^3H AND ^{14}C IN ORGANIC COMPOUNDS. Jordan, P.; Koeberle, P.; Lykourezos, A. P. (Eidgenoessisches Technische Hochschule, Zurich). Mikrochim. Ichnoanal. Acta, No. 4, 660-8(1965). (In German).

Experiences in the determination of ^3H and ^{14}C in organic compounds gathered in this laboratory over the past six years are reported. Improvements on the method used are described. (auth)

8846 USES OF X-RAY FLUORESCENCE IN TRACE ANALYSIS. I. ENRICHMENT OF TRACE METALS BY EXTRACTION. Pueschel, Richard (Metallwerk Plansee A. G., Reutte/Tirol, Austria). Mikrochim. Ichnoanal. Acta, No. 4, 770-86(1965). (In German).

The detection and determination of micro- and submicrogram quantities of trace metals can be accomplished through qualitative measurements and quantitative determinations of extracts by means of organic reagents that are evaporated on filter paper or on a carrier made of purest aluminum. The reproducibility, sensitivity, and determination limits of x-ray fluorescence analytical measurement procedures are discussed. The studies are being continued. (auth)

8847 RADIOACTIVATION ANALYSIS BASED ON QUANTITATIVE ISOTOPE DILUTION PRINCIPLE—DETERMINATION OF TRACE AMOUNTS OF GOLD BY A COMPARISON METHOD. Kudo, Kiyoshi (Nippon Telegraph and Telephone Public Corp., Ibaraki, Japan); Suzuki, Nobuo. Nippon Kagaku Zasshi, 86: 1050-3(Oct. 1965). (In Japanese).

Radioactivation analysis based on quantitative isotope dilution methods was studied. The comparison method for determining trace amounts of Au in pure Cu metal is considered. The experiment to determine the reaction ratio between Au and rhodamine B was carried out at various conditions and it was observed that the ratio is 1:1 in HCl solution containing 100 to 500 μg Au. The reproducibility of the results was satisfactory. An extraction procedure with substoichiometric amounts of rhodamine B was applied to the determination of trace amounts of Au. After a gold standard, M_s, and the copper metal to be analyzed were irradiated together, a greater amount of Au carrier, M, was added to each sample. The samples were dissolved separately and adjusted to suitable conditions for extraction. The same amount of Au, m(m < M), was separated from each by the extraction procedure with rhodamine B in $CHCl_3$ and the radioactivities a_s and a were measured. The unknown amount of Au, M_x, was easily calculated from $M_x = M_s \cdot a/a_s$. The mean contents of Au thus determined in commercial grade Cu and in 99.99% Cu were 2.4 and 0.04 ppM, respectively. (auth)

8848 MEASUREMENT OF MOISTURE IN CONCRETE AND MASONRY WITH SPECIAL REFERENCE TO NEUTRON SCATTERING TECHNIQUES. Waters, E. H. (Commonwealth Scientific and Industrial Research Organization, Melbourne). Nucl. Struct. Eng., 2: 494-500(Nov.-Dec. 1965).

Neutron scattering has been widely used to determine moisture in soils and has been advocated for other materials including concrete. The method is direct and nondestructive and requires access to only one side of the

specimen. Results have been claimed to depend solely on the water content, i.e., to be independent of the nature and density of the material. Experiments with concrete and timber have shown that this is not correct. Instrument response rises with density to such an extent that the same instrument response was obtained on a foamed concrete and a dense concrete with water contents in the ratio of 2:1. The composition of the sample also affects the response. This method therefore cannot safely be used with a common calibration curve for all substances. (auth)

8849 SEPARATION AND SPECTROPHOTOMETRIC DETERMINATION OF TRACE QUANTITIES OF LITHIUM IN HIGH-PURITY BERYLLIUM AND BERYLLIUM OXIDE. Apple, R. F. White, J. C. (Oak Ridge National Lab., Tenn.). Talanta, 13: 43-8(Jan. 1966). (ORNL-P-1168).

A spectrophotometric method is described for the determination of trace quantities of lithium in beryllium metal and its oxide. Lithium is selectively separated from beryllium by extraction from 1M potassium hydroxide solution into 0.1M dipivaloylmethane in diethyl ether. Fluoride, added before the extraction, successfully masks the beryllium; as little as 3 μg of lithium can be separated from as much as 1 g of beryllium. The lithium is then back-extracted into 0.1M hydrochloric acid and is determined spectrophotometrically with o-(2-hydroxy-3,6-disulpho-1-naphthylazo)benzene arsonic acid, Thoron. In an acetone-water medium Beer's law is obeyed over the range from 0.1 to 1.0 μg/ml. The method was applied successfully to the determination of lithium in concentrations as low as 3 ppM; the relative standard deviation for the determination of 200 ppM is 3%. (auth)

8850 DETERMINATION OF SULPHATE AND NITRATE IN PLUTONIUM COMPOUNDS BY INFRARED SPECTROSCOPY. Johnson, A. J.; Vejvoda, E. (Dow Chemical Co., Golden, Colo.). Talanta, 13: 81-6(Jan. 1966).

An infrared spectrophotometric method is described for the determination of sulfate and nitrate in plutonium peroxide and plutonium tetrafluoride. Spectra of the samples in potassium bromide pellets were obtained over the 4000 to 680 cm^{-1} region; sulfate was determined from the 1103 cm^{-1} absorption band and nitrate from the 1370 cm^{-1} band. Data are given on the precision and accuracy for analyses of peroxide and tetrafluoride samples. (auth)

8851 ON THE INFRARED SPECTROGRAPHIC ANALYSIS OF Y/La OXINATE MIXTURES. Neeb, R. (Univ., Mainz). Talanta, 13: 133-6(Jan. 1966). (In German).

Yttrium and lanthanum oxinates give, in the cesium bromide region, infrared absorption bands, which can be used for the analysis of mixtures of the elements after coprecipitation as oxinates. (auth)

8852 DETERMINATION OF ^{18}O IN INORGANIC COMPOUNDS. Shakhashiri, Bassam Z.; Gordon, Gilbert (Univ. of Maryland, College Park). Talanta, 13: 142-4 (Jan. 1966).

A relatively simple and rapid method was developed for determination of the ^{18}O content of many inorganic compounds including water. The samples were heated with silver cyanide at 500°C and the carbon dioxide formed was separated from the other products by means of a methylcyclohexane slush at −130°C and analyzed mass spectrometrically. (auth)

8853 GAS CHROMATOGRAPHIC DETERMINATION OF HELIUM IN NEUTRON-IRRADIATED BERYLLIUM OXIDE. Hibbits, James O. (General Electric Co., Cincinnati). Talanta, 13: 151-3(Jan. 1966).

A method was developed for determination of helium produced during neutron irradiation of beryllium oxide ($^9Be + n \rightarrow {}^8Be + 2n$; $^8Be \rightarrow 2{}^4He$). The sample was dissolved by refluxing in a sulfuric acid–phosphoric acid mixture in an argon atmosphere. After the sample had completely dissolved, the released helium was transferred to a gas sampling bulb by means of a Toepler pump. An activated charcoal trap cooled by liquid nitrogen was used to separate helium from argon. The helium was determined by gas chromatography using a 20-ft Linde 5A molecular sieve column. (auth)

8854 NON-DESTRUCTIVE NEUTRON-ACTIVATION ANALYSIS FOR DETERMINING THE CHLORINE CONTENT OF PAPER-PULP. Souliotis, A. G.; Grimanis, A. P.; Tsanos, N. A. (Nuclear Research Centre Democritus, Athens). Talanta, 13: 158-61(Jan. 1966).

Nondestructive neutron-activation analysis was used for determining chlorine in paper pulp. Numerical data were obtained for bleached and unbleached paper pulps of different types and origins. The sensitivity of this method was 100 ppM for an irradiation time of 30 min and a neutron flux of 6×10^{10} neutrons $\cdot cm^{-2} \cdot sec^{-1}$ and 10 ppM for an irradiation time of 1 min and a neutron flux of 2×10^{12} neutrons $\cdot cm^{-2} \cdot sec^{-1}$. In both cases the amount of chlorine that can be determined depended on the presence of the interfering elements manganese and sodium in the paper pulp. The time required for a complete analysis, after irradiation, was 5 min. (auth)

8855 X-RAY SPECTRAL AND ABSORPTION METHODS OF TARGET ANALYSIS. Karev, V. N.; Klyucharev, A. P. (Inst. of Physics and Tech., Kharkov). Ukr. Fiz. Zh., 10: 907-10(Sept. 1965). (In Ukrainian).

Stable-isotope target foils are usually prepared by the electrolysis of aqueous solutions, thermal dissociation of halides and thermal reduction. X-ray spectroscopy was found to be an excellent tool for determining the purity of the specimen by comparing the lines with those of a known reference standard. The thickness of the foil may be determined on the basis of the attenuation of the intensity. The method previously described (Ukr. Fix. Zh. 6: 628 (1963)) was used for determining the Mo admixtures in Ti, Cr, Zr and Hf foils. Comparison with data obtained by chemical analysis indicated that the average error did not exceed ±10%. Local density variations were determined both by the x-ray method and by direct micrometric measurements on Mg, Cr, Fe and Yb foils of various manufacture. It was found that the electrodeposited metals yielded uniform foil thickness. The uneven distribution of the material in Cr foils prepared by the decomposition of Cr iodide was attributed to a temperature gradient within the Mo support and uneven diffusion of the Cr iodide stream. The Mg and Yb foils prepared by thermal reduction were found to be quite uniform. The experimental error of the measurements did not exceed 7 and 3%, respectively. (TTT)

8856 DETERMINATION OF NITROGEN AND BORON BY FAST NEUTRON ACTIVATION METHOD. Naumova, I. I. Zavodsk. Lab., 31: 1205-7(1965). (In Russian).

A method for the activation determination of nitrogen and boron using fast neutrons and secondary reactions is proposed. Nitrogen and boron, on exposure to neutrons at 14-Mev, undergo the reactions $^{14}N(n,2n)^{13}N$ and $^{11}B(n,p)^{11}Be$. Reactor irradiation was used for the determination of B by the reactions $^{10}B(n,\alpha)^7Li$ and $^{10}B(\alpha,n)^{13}N$. The ^{13}N produced was measured by nondestructive radiochemical separation. (tr-auth)

8857 THE EFFECT OF THE INSTRUMENTAL ERROR ON THE PRECISION AND SENSITIVITY OF X-RAY SPECTROGRAPHIC ANALYSIS. COMMUNICATION 2. Lavrentiev, Yu. G.; Vainshtein, E. E. (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Anal. Khim., 20: 1033-7(1965). (In Russian).

The rational distribution of the counting time in x-ray spectrographic analysis with the ionization recording of intensity, which ensures a minimum experimental error for a determination, was considered. The theory of the effect of instrumental error on the precision and sensitivity of the x-ray spectrographic determination of elements was checked by taking as an example the determination of tantalum and titanium in Nb_2O_5. It is shown that the deductions from the theory and experimental data are in good agreement. (auth)

8858 SPECTROPHOTOMETRIC DETERMINATION OF SCANDIUM WITH SOME AZO DERIVATIVES OF 8-HYDROXYQUINOLINE. Busev, A. I.; Lunina, G. E. Zh. Anal. Khim., 20: 1069-72(1965). (In Russian).

The reactions of scandium ions with 7-(5-sulf-2-naphthylazo)-8-hydroxyquinoline-5-sulfonic acid, 7-(4, 8-disulfo-2-naphthylazo)-8-hydroxyquinoline-5-sulfonic acid, and 7-(5, 7-disulfo-2-naphthylazo)-8-hydroxyquinoline-5-sulfonic acid were studied. It was found that scandium reacts with these reagents in a molar ratio of 1:1. The molar extinction coefficients are correspondingly equal to 1.41×10^4, 1.45×10^4, and 1.52×10^4. The equilibrium constants are, respectively, 0.21×10^2, 0.23×10^2, and 0.35×10^2. (auth)

8859 EXTRACTION-PHOTOMETRIC DETERMINATION OF CERTAIN RARE EARTHS WITH THENOYLTRIFLUOROACETONE. Mishchenko, V. T.; Lauer, R. S.; Efryushina, N. P.; Poluektov, N. S. (Inst. of General and Inorganic Chemistry, Odessa). Zh. Anal. Khim., 20: 1073-81(1965). (In Russian).

Thenoyltrifluoroacetone and benzene were used for the extraction-photometric determination of rare earths. The absorption spectra of thenoyltrifluoroacetone complexes with Pr, Nd, Sm, Dy, Ho, Er, T_m, and Yb in benzene were studied. It was found that the peak heights of many of the absorption bands of the rare earths increased 1.1 to 4.0 times as compared with those of chloride solutions; for Ho, Er, and Nd they increased 21.1, 9.9, and 8.0 times, respectively. Conditions were found for determining Pr, Nd, Sm, Ho, and Er in a rare earth mixture. (auth)

8860 A STUDY OF YTTRIUM COMPLEXING WITH METHYLTHYMOL BLUE. Tereshin, G. S.; Rubinshtein, A. R.; Tananaev, I. V. (Kurnakov Inst. of General and Inorganic Chemistry, Moscow). Zh. Anal. Khim., 20: 1082-92(1965). (In Russian).

Absorption spectra of methylthymol blue aqueous solutions in relation to pH were studied. The first four dissociation constants of the reagent were calculated (pK_1 = 3.0, pK_2 = 3.3, pK_3 = 3.8, and pK_4 = 7.4). It was found by means of spectrophotometry and pH titration that yttrium ions form a 1:1 complex with the reagent. This complex contains, at pH ~ 4, not more than 2.5 equivalents of hydrogen ions per 1 equivalent of the reagent, at pH ~ 7 it has a composition $Y_2H_2I_2^{8-}$, and at pH ~ 10, a composition $Y_2I_2^{8-}$. In an excess of yttrium ions a V_2I complex is formed at pH ~ 7 and a $Y_2(OH)_jI^{j-}$ complex at pH > 7. At pH ~ 4 in an excess of reagent a complex is formed with a ratio of R/Y > 1. A general instability constant of the $Y_2H_2I_2^{8-}$ complex (pK = 50.4 ± 0.6) and its acid dissociation constants (pK_1^H = 8.0, pK_2^H = 9.5) were calculated. A general instability constant of the $Y_2I_2^{8-}$ complex (pK = 37) was found. Methylthymol blue was used as a metallochromic indicator for the determination of yttrium by a complexometric and a spectrophotometric methods. (auth)

8861 THE ANALYTICAL CHEMISTRY OF THORIUM. COMMUNICATION 4. COMPLEXONOMETRIC DETERMINATION OF THORIUM IN MONAZITE CONCENTRATES AFTER ITS ISOLATION BY MEANS OF INDENYL-2-PHOSPHONIC ACID. Lukyanov, V. F.; Kozlova, A. B. Zh. Anal. Khim., 20: 1097-9(1965). (In Russian).

A method is described for determining thorium in monazite concentrates after separation of thorium with indenyl-2-phosphonic acid from a 4N hydrochloric acid solution. The accuracy of the method is 1 to 1.5% at a thorium concentration of 5 to 7%. (auth)

8862 GAS CELL, 10 MM I. R. (Engineering Materials). (Rocky Flats Plant, Dow Chemical Co., Denver, Colo.). (CAPE-1270).

1 drawing.

The cell described permits multi-correlation of infrared, gas chromatographic, and mass spectrometric analyses. Samples contained in the small volume cell (85 cc) are analyzed by each of the three methods without sample loss in transfer. The cell body is machined from brass bar stock. An internal taper conforms to a spectrophotometer beam. Two bosses silver-soldered to the cell body permit attachment to the mass spectrometer. The assembly is gold plated. Windows of 3, 4, or 6 mm thickness depending on gas pressure are attached to the cell. The cell was tested at 50 psig using 6 mm NaCl windows. (For details, see TID-4100) (M.C.G.)

8863 SEPARATION AND DETERMINATION OF THORIUM AND RARE EARTHS IN URANIUM COMPOUNDS BY MEANS OF ISOTOPIC DILUTION ANALYSIS. Lopez, Ana; Lima, Fausto W. (Univ., Chile, Santiago. Institut de Energia Atomica, Sao Paulo, Brazil). pp 23-8 of Primera Conferencia Interamericana de Radioquimica. Washington, D. C., Union Panamericana, 1965. (In Spanish).

A method for the separation and determination of thorium and rare earths in uranium compounds using the isotopic dilution method is described. The preliminary results obtained are tabulated. (J.S.R.)

8864 RADIOCHEMICALLY CONTROLLED SEPARATION AND IDENTIFICATION OF CADMIUM IN THE PRESENCE OF COPPER WITH CUPFERRON. Abrao, Alcidio (Instituto de Energia Atomica, Sao Paulo, Brazil). pp 29-32 of Primera Conferencia Interamericana de Radioquimica. Washington, D. C., Union Panamericana, 1965.

A procedure for the separation and identification of cadmium in the presence of copper is suggested. The separation is achieved with cupferron. The separation of Cd from Cu in a mixture of both elements with cupferron allowed a 95% recovery of copper and 99% recovery of cadmium in the μg range. The copper cupferrate can be filtered or extracted with cupferron. The copper can be determined by direct polarography by dissolving the precipitate with the ammonium salt of EDTA and ammonium hydroxide. ^{115}Cd and ^{64}Cu were used as tracers. (J.S.R.)

8865 DETERMINATION OF PHOSPHORUS IN URANIUM BY ISOTOPE DILUTION ANALYSIS. Lima, Fausto W.; Atalla, Laura T. (Instituto de Energia Atomica, Sao Paulo, Brazil). pp 45-50 of Primera Conferencia Interamericana de Radioquimica. Washington, D. C., Union Panamericana, 1965.

The applicability of the isotopic dilution method to the determination of phosphorus in uranium samples was investigated by analysis of uranium samples containing amounts of phosphorus easily determined by ordinary chemical methods. The interference of Si, As, and V were determined. An outline of the recommended procedure is given. (J.S.R.)

8866 NEUTRON ACTIVATION ANALYSIS OF HUMAN HAIRS AND NAILS FOR DETERMINING ARSENIC TRACES. Gomez, Hector; Baro, Gregorio B. (Comision Nacional de Energia Atomica, Buenos Aires). pp 51-5 of Primera Conferencia Interamericana de Radioquimica. Washington, D. C.; Union Panamericana, 1965. (In Spanish).

The neutron activation method used for determination of As traces in the hairs and nails of a person believed to be suffering from chronic As poisoning is described. Each irradiation of samples from the patient was accompanied by the simultaneous irradiation of samples from a normal person. The results showed an abnormally high concentration of As in the person suspected of As poisoning. (J.S.R.)

8867 INVESTIGATION OF RAPID SEPARATION TECHNIQUES FOR Ge, Se, AND As FOR THE PURPOSE OF ACTIVATION ANALYSIS. Campa, Jaime Pahissa (Comision Nacional de Energia Atomica, Buenos Aires). pp 57-60 of Primera Conferencia Interamericana de Radioquimica. Washington, D. C., Union Panamericana, 1965. (In Spanish).

In the activation analysis determination of Ge, Se, and As, fast separation techniques are necessary. Tracer studies were made of the separation procedures to determine the efficiency of each. The results showed that the separation of Ge by distillation of germanium tetrachloride is almost quantitative and gives reproducible results. The separation

of Se by precipitation, redissolution, and reprecipitation gave acceptable results with respect to yield but not with respect to reproducibility. Arsenic was precipitated as magnesium ammonium arsenate and the yields were satisfactory if the precipitation took longer than 3 min. (J.S.R.)

8868 CALIBRATION OF ^{140}Ba AND ^{140}La MIXTURES NOT IN RADIOACTIVE EQUILIBRIUM. Pasques, R. H. Rodriguez (Comision Nacional de Energia Atomica, Buenos Aires). pp 93-7 of Primera Conferencia Interamericana de Radioquimica. Washington, D. C., Union Panamericana, 1965. (In Spanish).

A method for routine measurement of the absolute activity of solutions of ^{140}Ba mixed with ^{140}La is reported. The method is based on the unequal absorption of the radiations from the two elements by an Al filter placed between the radioactive source and the Geiger counter. The method developed is simple and rapid. It is not necessary to know the time of the purification of the Ba. (J.S.R.)

8869 CALIBRATION OF ^{132}Te USING GEIGER TUBE. Pasques, R. H. Rodriguez (Comision Nacional de Energia Atomica, Buenos Aires). pp 99-103 of Primera Conferencia Interamericana de Radioquimica. Washington, D. C., Union Panamericana, 1965. (In Spanish).

A simple method for the determination of ^{132}Te was developed. It is based on the measurement of the increase of ^{132}I. The procedure is given and it was verified that radioisotopes accompanying Te do not cause any important error in the determination. (J.S.R.)

8870 NEW METHODS FOR THE CALIBRATION OF γ-EMITTING NUCLIDES. Aten, A. H. W. Jr. (Instituut voor Kernphysisch Onderzoeek, Amsterdam). pp 121-30 of Primera Conferencia Interamericana de Radioquimica. Washington, D. C., Union Panamericana, 1965.

Methods for the calibration of γ-emitting nuclides when a complete scintilligram of the nuclide emitting 2 or more γ rays in cascade is available are presented. The use of these methods for calibration of ^{46}Sc, ^{60}Co, and ^{22}Na is shown. (tr-auth)

8871 MODERN NEUTRON ACTIVATION ANALYSIS NEW TECHNIQUES AND NEW APPLICATIONS. Guinn, Vincent P. (General Atomic Div., General Dynamics Corp., San Diego, Calif.). pp 317-27 of Primera Conferencia Interamericana de Radioquimica. Washington, D. C., Union Panamericana, 1965.

The major developments in apparatus and techniques for neutron activation analysis are reviewed. The principal apparatus developments are small accelerators, research reactors, and multichannel pulse height analyzers. Each of these is described. The techniques developed include the purely instrumental method, spectrum stripping, computer calculations, fast radiochemical separations, and reactor pulsing. Neutron activation analysis was applied to the field of criminalistics, pesticide residue determinations, and trace element determination in biological samples. (J.S.R.)

8872 A STUDY OF THE HYDROLYSIS OF URANIUM CARBIDES. Besson, J. (Centre d'Etudes Nucleaires de Grenoble, Isere, France); Blum, P.; Spitz, J. pp 273-9 of Carbides in Nuclear Energy. Vol. 1. Russell, L. E. (ed.). London, Macmillan and Co., Ltd., 1964.

The hydrolysis of UC in neutral or acid medium leads to the formation of a complex mixture of hydrogen and mostly saturated hydrocarbons. When UC–U alloys are dissolved in hydrochloric-phosphoric medium, the free contents can be determined with good accuracy from the composition of the gaseous phase. The hydrolysis of mixtures of UC and UC_2 in neutral or acid medium, leads to the formation of a complex mixture of hydrogen and gaseous and condensed hydrocarbons, the composition of which is principally dependent upon the UC_2 content. The reaction mechanisms that are presented for the hydrolysis of UC and UC_2 can account for all experimental observations. (auth)

8873 THE CHEMICAL ANALYSIS OF ACTINIDE CARBIDE CERAMICS AND CERMETS FOR MAIN CONSTITUENTS. Milner, G. W. C. (Atomic Energy Research Establishment, Harwell, Eng.); Phillips, G.; Jones, I. G.; Crossley, D.; Rowe, D. H. pp 447-56 of Carbides in Nuclear Energy. Vol. 1. Russell, L. E. (ed.). London, Macmillan and Co., Ltd., 1964.

The determination of the main constituents of actinide carbide systems is described. Samples include uranium carbides, plutonium carbides, binary mixtures containing up to 15% of plutonium carbide and cermets of the binary mixtures with up to 10% by weight of iron or molybdenum. Carbon contents of all these materials were determined by combustion in oxygen followed by measurement of the carbon dioxide manometrically. Nitrogen contents can be fairly high due to the reactivity of carbides with air, and a chemical method of analysis was employed for samples containing up to about 0.25 wt%. This involves dissolution of the sample, separation of the nitrogen as ammonia by distillation and completion of the determination absorptiometrically with Nessler's reagent. For samples with higher nitrogen contents, the Dumas method was employed. For the determination of uranium and plutonium, the analysis is preceded by ignition to oxide by controlled oxidation in air, followed by dissolution in nitric acid with the addition of some hydrofluoric acid. With binary samples uranium and plutonium are separated by anion exchange from 8M HNO_3, before determination of the uranium content gravimetrically or volumetrically and the plutonium content by differential spectrophotometry. The uranium contents of samples containing ^{235}U were determined by γ-spectrometry by measurement of the 185 kev gamma peak after allowing the interfering 210 kev gamma ($t_{½}$ 6.75 days) from ^{237}U to decay. The iron contents of cermets were obtained by controlled-potential coulometry in 3N H_2SO_4 after separation of plutonium by ion exchange. For molybdenum, a differential spectrophotometric method, based on the formation of the molybdenum thiocyanate color in the presence of uranium and plutonium was employed. (auth)

8874 THE DETERMINATION OF MINOR CONSTITUENTS AND CONTAMINANTS IN ACTINIDE CARBIDE CERAMICS AND CERMETS. Taylor, B. L. (Atomic Energy Research Establishment, Harwell, Eng.); Milner, G. W. C.; Birks, F. T.; Prior, H. A. pp 457-68 of Carbides in Nuclear Energy. Vol. 1. Russell, L. E. (ed.). London, Macmillan and Co., Ltd., 1964.

The minor constituents and contaminants, present in the actinide carbide systems studied at AERE, have included oxygen, tungsten, iron, nickel and porcelain, and the analytical procedures employed for the determination of these constituents are described. Oxygen contents of carbides are variable depending upon the method of preparation and upon the efficiency of preventing contamination by air. A semi-micro vacuum fusion method was used for the determination of this constituent. The apparatus is incorporated into glove-boxes for containment of the α-active material and the design is such that samples can be maintained in a dry argon atmosphere throughout. Determinations are generally carried out on uncrushed samples to avoid oxygen pickup during the crushing process, but difficulties can arise in some of the lump samples due to the inhomogeneous distribution of oxygen. With homogeneous samples, a coefficient of variation of approximately 7% is obtained at the 0.1 oxygen level on using 50 mg sample weights. The spectrographic method is used for the determination of the other constituents, since it is both rapid and convenient. Carbide samples are first converted to oxides and then the Scribner-Mullin carrier distillation method is applied. This method has proved satisfactory for the determination of tungsten contents in the range from 200 ppm to at least 1%. Contamination from tungsten has arisen from tungsten electrodes in the arc melting of carbides and from tungsten carbide balls in ball-milling processes. Contamination from iron and porcelain has also occurred during ball-milling, from the use of steel and porcelain balls. The spectrographic method was employed to determine small amounts of nickel and tungsten in experiments to study the effects of small additions of these elements on the sintering behavior of carbides. (auth)

8875 PROCESS FOR THE ANALYSIS OF ISOTOPES AND THE APPARATUS FOR THIS PURPOSE. (to United Kingdom Atomic Energy Authority). British Patent 1,010,319. Nov. 17, 1965. Priority date Oct. 15, 1963, Austria.

An apparatus is described for use with a mass spectrometer for the vaporization of substances that are normally difficult to vaporize without separate chemical preparation. The ion source adapted for connection to the mass spectrometer has a refractory furnace chamber for receiving the sample and an ionization chamber connected to the furnace chamber. The furnace chamber has inlet means for introducing a gas stream containing a reactant suitable for promoting vaporization of the sample. The vaporized material is passed to the ionization chamber for ionization, and the beam of ions is then directed into the mass spectrometer. (B.L.M.)

8876 METHOD OF ANALYSIS OF POLYPHENYL MIXTURES BY THIN-LAYER CHROMATOGRAPHY. Schlitt, Helmut (to Commissariat a l'Energie Atomique). U. S. Patent 3,215,498. Nov. 2, 1965. Priority date Oct. 19, 1961, Germany.

A solution of tetravalent cerium sulfate in concentrated nitric acid is proposed as a color indicator in the analysis of polyphenyl mixtures by thin-layer chromatography. (B.L.M.)

8877 METHOD AND APPARATUS FOR PRODUCING A SPECTROSCOPIC EMISSION SPECTRUM OF A MATERIAL. Wehner, Gottfried K. (to Litton Systems Inc.). U. S. Patent 3,217,162. Nov. 9, 1965. Filed Apr. 14, 1961.

A spectroscopic device is described in which a low pressure high density plasma is used in the sputtering source to convert the material to be analyzed to the gaseous form. The sputtered atoms are then excited to higher energy levels, and their return to normally stable lower energy levels results in energy release that provides an emission spectrum of the material. With this device, the continuum background is eliminated in the emission spectrum, and diffusion in the bulk of the material is eliminated. (B.L.M.)

Inorganic and Physical Chemistry

8878 (CONF-650559-9) THERMODYNAMIC PROPERTIES OF ALKALI-METAL VAPORS. Miller, David (Argonne National Lab., Ill.). [1964]. Contract W-31-109-eng-38. 14p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From American Institute of Chemical Engineers, 56th National Meeting, San Francisco.

Calculations for potential energy curves and second virial coefficients of alkali metal vapors are discussed. (P.C.H.)

8879 (COO-1020-7) CHELATION AND OLATION REACTIONS OF METAL IONS IN AQUEOUS SOLUTION. PART V. MIXED LIGAND COMPLEXES OF U(IV). Progress Report. Carey, G. H.; Martell, Arthur E. (Illinois Inst. of Tech., Chicago). 1964. Contract AT(11-1)-1020. 16p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Sufficient amounts of various bidentate ligands were added to the 1:1 aqueous solutions of U(IV) with EDTA and NTA (nitrilotriacetic acid) in order to fill completely the coordination sphere of the metal. In order to accomplish this with EDTA, a 1:1:1 molar ratio of U(IV) to sexadentate the bidentate ligands was employed, while with NTA a 1:1:2 molar ratio of U(IV):NTA:bidentate ligand was used. The bidentate ligands used were: disodium 1,2-dihydroxybenzene-3,5-disulfonate (Tiron); pyrocatechol; iminodiacetic acid; 8-hydroxy-5-quinolinesulfonic acid; and 5-sulfosalicylic acid. The mixed ligand chelates of U(IV) were found to be extremely stable since the addition of the bidentate supplementary ligand completely fills the coordination sphere of the metal and hence no reactive sites remain on the metal ion through which hydrolysis or olation reactions can occur. (P.C.H.)

8880 (COO-1020-10) CHELATION AND OLATION REACTIONS OF METAL IONS IN AQUEOUS SOLUTION. PART IV. EQUILIBRIUM STUDIES OF URANYL COMPLEXES. IV. REACTIONS WITH CARBOXYLIC ACIDS. Progress Report. Rajan, K. S.; Martell, A. E. (Illinois Inst. of Tech., Chicago). 1964. Contract AT(11-1)-1020. 15p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Equilibria involved in the interaction of uranyl ion and phthalic, maleic, and oxalic acids in aqueous solutions were investigated quantitatively by means of potentiometric measurements of hydrogen ion concentration at 25° and ionic strength 1.0 (KNO_3). Phthalic and maleic acids form 1:1 complex with uranyl ion. Oxalic acid interacts strongly with uranyl ion to form a complex having a 1:2 molar ratio of metal to ligand. On the basis of potentiometric measurements carried out over 20-fold range of concentration of total metal, it was concluded that only mononuclear chelates are formed in the pH range 2 to 4. The values of the formation constants (K_{ML}) for UO_2-phthalate and maleate systems were found to be 4.38 ± 0.03 and 4.46 ± 0.05, respectively, and β_{ML_2} for the oxalate system 9.08 ± 0.24. (auth)

8881 (HW-SA-3777) ORGANOPHOSPHORUS-URANYL COMPLEXES STUDIED BY NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY. Burdett, Jane L.; Burger, L. L. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). Nov. 18, 1964. Contract AT(45-1)-1350. 18p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

The effect of extraction of uranyl nitrate on certain neutral organophosphorus compounds was observed by nuclear magnetic resonance (NMR) spectroscopy. Proton and phosphorus chemical shifts were measured for the complexed and uncomplexed material. The effect of complexation on proton-proton and proton-phosphorus coupling constants was noted. (auth)

8882 (IS-983) MASS SPECTROMETRY OF VOLATILE INORGANIC COMPOUNDS. Svec, Harry J. (Ames Lab., Iowa State Univ. of Science and Tech.). Nov. 1, 1965. Contract W-7405-eng-42. 31p. (CONF-640812-1). Dep. mn; CFSTI $2.00 cy, $0.50 mn.

From Meeting on Mass Spectrometry, Glasgow.

Results on mass spectra of volatile inorganic halides, metal carbonyls, and hydrides are reported, and problems associated with the measurements are discussed. It was concluded that the application of appearance potential data to calculating thermochemical properties of inorganic compounds, not amenable to calorimetric measurements, can be on firm ground if enough is known about all of the parameters involved in an appearance potential value. (P.C.H.)

8883 (LA-DC-6135) VISCOSITY OF CESIUM VAPOR. Weaver, C. V.; Stratton, F. F. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). [1964]. Contract W-7405-eng-36. 6p. (CONF-651049-4). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From IEEE Thermionic Conversion Specialist Conference, San Diego, Calif.

The viscosity of cesium vapor was determined by a transpiration technique in the temperature range of 800 to 2000°K. In this temperature interval, the viscosity may be represented by the relation: $\mu = .99 \times 10^{-9}\, T^{1.73}$ gm/cm-sec. The temperature index is too large to allow the viscosity to be described by a Lennard-Jones potential. Above 1400°K the temperature index decreases rapidly; above 1800°K it becomes negative. Ionization appears to be inadequate to explain the reduction in the temperature index. Atom-atom collision diameters calculated from the viscosity data vary from 9.3 to 6.6 Å over the temperature interval from 800 to 1400°K. (auth)

8884 (NASA-CR-353) ANALYSES OF VAPORIZATION IN LIQUID URANIUM BEARING SYSTEMS AT VERY HIGH TEMPERATURES. Kaufman, L.; Peters, E. T. (Manlabs, Inc., Cambridge, Mass.). Dec. 1965. Contract NAS-3-7168. 31p. CFSTI $2.00 cy, $0.50 mn.

The vapor pressures of the C-Nb-U and C-U-Zr systems were calculated to 10,000°R in order to evaluate their use as heat exchangers for H_2 gas at 100 atm pres-

sure and 8000 to 10,000°R. Neither of the systems fulfilled the conditions imposed by the requirements of a high impulse nuclear engine. (W.L.G.)

8885 (ORNL–3830, pp 275-84) PREPARATION AND PROPERTIES OF ACTINIDE-ELEMENT OXIDES. (Oak Ridge National Lab., Tenn.).

Activities in a program to determine the microstructural, surface-chemical and colloid-chemical properties of ThO_2 are summarized. Information is included on adsorption of HNO_3 on colloidal ThO_2, viscosity of dilute ThO_2 sols, and surface and sintering properties of sol-gel ThO_2. (J.R.D.)

8886 (SC-DC–65-1792) PHASE DIAGRAM AND CONDUCTIVITIES FOR THERMAL CELL, TERNARY SALT MIXTURE. Goldsmith, Henry J.; Blucher, Richard L.; Mattheu, Henry W. (Catalyst Research Corp., Baltimore, Md.). Oct. 12, 1965. Contract AT(29-1)-789. 32p. (CONF-651204–1). Dep. mn; CFSTI $2.00 cy, $0.50 mn.

From Electrochemical Society Conference, Los Angeles.

The ternary phase diagram for the system $CaCrO_4$–LiCl–KCl was determined to fifty weight percent $CaCrO_4$ while binary phase diagrams were determined for the systems KCl–$CaCrO_4$ and LiCl–$CaCrO_4$. Conductivities of the ternary system were determined from five to forty-four percent $CaCrO_4$ at various LiCl/KCl ratios. It was found that two detrimental factors such as high $CaCrO_4$ content and high melting point can be offset by a favorable LiCl/KCl ratio. This, however, does not hold true over the entire range, cannot be predicted, and experimental determinations are shown to be a necessity. (auth)

8887 (SRIA–425-7) SORPTION OF GASES ON METAL SURFACES IN ULTRAHIGH VACUUM. Quarterly Progress Report No. 12, August 15–November 15, 1965. Bergsnov-Hansen, B.; Endow, N.; Evans, B.; Pasternak, R. A. (Stanford Research Inst., Menlo Park, Calif.). Nov. 26, 1965. Contract AT(04-3)-425. 9p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

Progress in studies on the adsorption of D by evaporated Mo films and the solution of N_2 and O_2 in Nb is reported. (W.L.G.)

8888 (UCRL–12205) PREPARATION AND CELL PARAMETERS OF LuB_2C_2. Nordine, Paul C.; Smith, Gordon S.; Johnson, Quintin (Lawrence Radiation Lab., Univ. of California, Livermore). Nov. 19, 1964. Contract W-7405-eng-48. 5p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

The occurrence of LuB_2C_2 and conformation of lattice parameters of the compound to trends previously established were studied. The lattice parameters obtained were: $\underline{a} = 5.321 \pm 0.001$, $\underline{c} = 3.447 \pm 0.001$ Å (based on $\lambda\ CuK\alpha_1 = 1.54050$ Å). The overall decrease in $\underline{a}$ from La through Lu is 1.5%; the corresponding decrease in $\underline{c}$ is 12.9%. Thus the $\underline{c}$ parameter plot is not linear. In terms of the previously proposed structure where the bond distances are determined solely by cell dimensions, the small change in $\underline{a}$ corresponds to a shortening of the B–C bond distances from 1.58 Å in LaB_2C_2 to 1.55 Å in LuB_2C_2, and hence, formally to a progressive change in the bond-character of the B–C bonds. (P.C.H.)

8889 (UCRL–16407) THE CALCULATION OF VAPOR-LIQUID-EQUILIBRIA FROM AN EQUATION OF STATE. Holberg, J. A. (Lawrence Radiation Lab., Univ. of California, Berkeley). Sept. 1965. Contract W-7405-eng-48. 56p. Dep. mn. CFSTI $3.00 cy, $0.50 mn.

A complete equation of state for the gaseous and liquid phases contains implicitly a description of the vapor-liquid equilibrium. An equation of state (ES64) previously suggested was used for a computer program predicting pressure and vapor composition when the temperature, the liquid composition, and three parameters (required by the equation of state) for each component are given. The results obtained were compared with literature data for a number of binary and ternary systems. (auth)

8890 (WAPD-TM–511) SOLUBILITY OF CARBON DIOXIDE IN THE AMMONIUM CITRATE SOLUTION OF THE APAC PROCESS. Lloyd, R. (Bettis Atomic Power Lab., Pittsburgh, Pa.). Nov. 1965. Contract AT-11-1-Gen-14. 10p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Experimental measurements were made of the solubility of carbon dioxide in the ammonium citrate solution of the Dilute APAC Decontaminating Process, which contains 0.053 mole/liter of ammonium citrate. The carbon dioxide was found to exist in the solution in both a fixed state and in an unfixed or strippable state. The fixed species, existing in the form of bicarbonate and carbonate salts, could not be stripped from the solution by heating it under reduced pressure; the unfixed species, existing in the form of dissolved gas or carbonic acid, could be readily stripped. On exposure to carbon dioxide the ammonium citrate solution dissolved an equilibrium fixed concentration of carbon dioxide ranging from 4.1 to 5.9 millimoles/liter at pH 4 to 7, which was practically independent of the partial pressure of carbon dioxide (up to 1 atmosphere) and the temperature of the solution (in the range of 80 to 140°F). In addition to this fixed concentration, the solution dissolved also an unfixed concentration of carbon dioxide whose equilibrium value depended on the pH and temperature of the solution and upon the partial pressure of the gas. At the partial pressures of carbon dioxide normally extant in the air, the total equilibrium concentration of carbon dioxide dissolved at 120°F in a 12 grams/liter diammonium citrate solution of pH 5 was 4.95 millimoles/liter. (auth)

8891 STUDIES OF METAL COMPLEXES OF RADIOBIOLOGICAL INTEREST. II. THE SOLUBILITY AND STABILITY CONSTANTS OF Ca, Sr, AND Ba CROCONATES. Carlqvist, Birger; Dyrssen, David (Research Inst. of National Defense, Stockholm). Acta Chem. Scand., 19: 1293-6(1965).

Using solubility columns the following equilibrium constants (±0.03) were determined in K_2A-KCl mixtures at I = 0.3M and 25°C: A^{2-} = croconate ion; $\beta_1 = [MA]\ [M^{2+}]^{-1}\ [A^{2-}]^{-1}$; $K_{s1} = [MA]$; $K_{s0} = K_{s1}/\beta_1$ (solubility product). For CaA, $\log \beta_1 = 1.29$, $\log K_{s1} = -2.76$, and $\log K_{s0} = -4.05$; for SrA, $\log \beta_1 = 1.21$, $\log K_{s1} = -3.87$, and $\log K_{s0} = -5.08$; and for BaA, $\log \beta_1 = 1.55$, $\log K_{s1} = -6.73$, and $\log K_{s0} = -8.28$. (auth)

8892 ON THE CRYSTAL STRUCTURES OF HoOOH, ErOOH, AND YbOOH. Christensen, A. Noerlund (Univ. of Aarhus, Denmark). Acta Chem. Scand., 19: 1391-6 (1965).

Hydrothermal methods were used in the preparation of HoOOH, ErOOH, and YbOOH. Holmium oxide hydroxide, HoOOH, is monoclinic; the space group is $P2_1/m$, with a = 5.96, b = 3.64, and c = 4.31 Å, $\beta = 109.1°$, and two formula units per unit cell. Each holmium atom is coordinated with seven oxygen atoms; one oxygen is coordinated with three holmium atoms, and the other with four holmium atoms. Six oxygens form a trigonal prism, and the seventh lies along a normal to a prism face. Atomic coordinates, temperature factors and other relevant crystallographic data are reported. The structures of ErOOH and YbOOH are shown to be similar to HoOOH. They are all isostructural with YOOH. (auth)

8893 A REINVESTIGATION OF THE CRYSTAL STRUCTURE OF YOOH. Christensen, A. Noerlund (Univ. of Aarhus, Denmark). Acta Chem. Scand., 19: 1504-5(1965).

The crystal structure of YOOH was reinvestigated to determine the Y-O distances from counter diffractometer data. Atomic coordinates and temperature factor coefficients with their standard deviations and interatomic distances are given. The investigation confirmed previous results. The following unit cell parameters were obtained: a = 5.95, b = 3.65, and c = 4.30 Å and $\beta = 112.7°$. The Y contributions determine almost all the signs of the structure factors of the (hkl) reflections. Possible oxygen positions at (0.06, 0.75, $\overline{0.76}$) and (0.56, 0.75, 0.76) were calculated. (J.F.H.)

8894 SOLVENT EXTRACTION STUDY OF TRIVALENT ACTINIDE AND LANTHANIDE COMPLEXES IN AQUEOUS SOLUTIONS. IV. THIOCYANATE COMPLEXES OF La(III), Eu(III), Lu(III), AND Am(III) IN 5M $Na(ClO_4)$ SOLUTIONS AT 25 deg C. Sekine, Tatsuya (Royal Inst. of Tech., Stockholm). Acta Chem. Scand., 19: 1519-25 (1965).

The complex formation of La(III), Eu(III), Lu(III), and Am(III) with thiocyanate ions was studied in 5M $Na(ClO_4)$ at 25°C by a distribution method. The metal ions in aqueous solution were equilibrated with 2-thenoyltrifluoroacetone in carbon tetrachloride containing tributyl phosphate or methyl isobutyl ketone, and the complex formation was determined from the decrease of the distribution ratio when various amounts of thiocyanate ion were introduced in the solution. The stability constants of the thiocyanate complexes were calculated by a generalized least squares method using the LETAGROP VRID computer program. The results indicated that Am(III) forms more stable thiocyanate complexes than the other three ions and that the second complexes, $M(SCN)_2^+$, are not as stable as the other complexes of the same ion. (auth)

8895 ON CATION HYDRATION IN HEAVY WATER. Vdovenko, V. M.; Gurikov, Yu. V.; Legin, E. K. At. Energ. (USSR), 19: 433-7(Nov. 1965). (In Russian).

An account is given of the use of the molecular-kinetic description of the two-layer model of hydration for the analysis of the isotopic differences of the free energy and enthalpy of solution in water and heavy-water solutions of alkali metal halides. The lifetime and distribution density of water molecules in the layer of secondary hydration are examined. It is shown that in heavy-water solutions dehydration of the ions occurs. It is established that the difference of free energy and enthalpy of solution in light and heavy water should increase with an increase of the cation radius, i.e., from Li^+ to Cs^+. The results obtained agree with experimental data. (tr-auth)

8896 BINARY SYSTEM UF_4–UCl_4. Khripin, L. A.; Gagarinskii, Yu. V.; Zadneprovskii, G. M.; Luk'yanova, L. A. At. Energ. (USSR), 19: 437-41(Nov. 1965). (In Russian).

The binary system UF_4–UCl_4 was studied by the methods of differential thermal analysis and x radiography, and its phase diagram was constructed. Three compounds are formed in the system: the dichloride difluoride UCl_2F_2, the monochloride trifluoride $UClF_3$, and the trichloride monofluoride UCl_3F, obtained for the first time. The compounds melt incongruently at temperatures of 460 ± 3, 530 ± 6, and 444 ± 2°C, respectively. The optimum conditions of preparation of these compounds in pure form from the melts of the system were determined in general outline. On the basis of the phase diagram of the UF_4–UCl_4 system an explanation is given for the contradictory results obtained in previous studies of methods of synthesis of UCl_2F_2 and $UClF_3$. (tr-auth)

8897 THE DISSOLUTION OF BERYLLIA IN MOLTEN ALKALI METAL HYDROXIDES. Shying, M. E.; (Australian Atomic Energy Commission Research Establishment, Lucas Heights, Sydney); Aggett, J.; Temple, R. B. Austral. J. Chem., 18: 1719-29(Nov. 1965).

Beryllium oxide showed a limited reversible solubility in molten alkali metal hydroxides only when dissolved water vapor was present. The reaction taking place was studied in detail. The results obtained were consistent with the reversible formation of the beryllate ion $[Be(OH)_4]^{2-}$ as the major product, according to the equation $BeO(solid) + H_2O(dissolved) + 2OH^- \rightleftharpoons [Be(OH)_4]^{2-}(dissolved)$. The enthalpy of the reaction was calculated to be 4.8 kcal/mole over the temperature range from 240 to 510°C. (auth)

8898 STRUCTURE AND CHARACTER OF THE METAL–OXYGEN BOND IN METAL OXALATES. I. INFRARED SPECTRA OF RARE EARTH METAL OXALATES OF THE GENERAL FORMULA $Ln_2ox_3 \cdot nH_2O$. Grzymalski, Z.; Jezowska-Trzebiatowska, B.; Ziolkowski, J. (Univ. Wroclaw, Poland). Bull. Acad. Pol. Sci., Ser. Sci. Chim., 13: 475-80(1965).

Results of infrared spectra studies of rare earth oxalates with the general formula $Ln_2OX_3 \cdot nH_2O$ are presented, where Ln is a rare earth element, La, Ce, Pr, Nd, Sm, Eu, Gd, Th, Dy, Ho, Er, and Yb, and n is equal to 5, 6, or 10. The absorption spectra were obtained within the range of 400 to 2000 cm^{-1} with KBr and NaCl prisms. Characteristics of the metal–oxygen bond covalency in lanthanide oxalates were determined. Data are presented in tables and graphs. (F.J.H.)

8899 AN ISOTOPIC EXCHANGE REACTION BETWEEN OXYGEN AND CARBON DIOXIDE ON ZINC OXIDE. Titani, Toshizo; Kiyoura, Tadamitsu; Adachi, Akira (Tokyo Metropolitan Univ.). Bull. Chem. Soc. Jap., 38: 2075-8(Dec. 1965).

Isotopic oxygen exchange reactions between carbon dioxide and zinc oxide, and between oxygen and carbon dioxide on zinc oxide, were studied by the static method in the temperature range from 350 to 550°C. At any temperature carbon dioxide exchanged its oxygen atoms with those of zinc oxide rapidly. Within a few minutes after initiation of the reaction, an isotopic equilibrium was established between the carbon dioxide in the gas phase and a certain part of the zinc oxide. It was found that isotopic exchange between oxygen and carbon dioxide on zinc oxide takes place through the exchange between these gases and the oxygen atoms of the zinc oxide, that the limiting step is the exchange with oxygen, and that the carbon dioxide acts as an inhibitor of the exchange between oxygen and zinc oxide. (auth)

8900 REFRACTORY BORIDES: SPECIAL STUDY OF THE BORIDES OF TITANIUM AND ZIRCONIUM—PREPARATION, PROPERTIES AND APPLICATIONS. Meyer, Rene; Pastor, Henri (Societe Ugine-Carbone, Grenoble, France). Bull. Soc. Franc. Ceram., No. 66, 59-80(Jan.-Mar. 1965). (In French).

The place that borides occupy among refractory materials and their characteristic properties were examined. Methods for preparation of the powders, shaping by compaction followed by sintering and hot-pressing, and special chemical properties are discussed. A method of attacking borides suitable for their rapid analysis is considered. The properties and known uses of borides and some special applications (for the electrodes of molten electrolysis cells and for the containers heated by the Joule effect in the vacuum-evaporation of metals) are described. (auth)

8901 ANISOTROPIC REACTIVITIES OF GRAPHITE. I. REACTIONS OF OZONE AND GRAPHITE. Hennig, Gerhart R. (Argonne National Lab., Ill.). Carbon, 3: 107-14(Oct. 1965).

The reaction rates of ozone with single crystals of graphite were measured separately in directions parallel and perpendicular to the layer planes, by using the techniques of etch decoration. The rates were found to be exceedingly sensitive to various pretreatments of the crystals, and even to the material used for supporting the crystals. It is believed that the most reliable rates were obtained on crystals supported on polycrystalline graphite and pretreated at 900°C in purified helium prior to reacting with ozone. Under these conditions, the rate of the parallel reaction was 900 times faster than the rate of the perpendicular reaction. The apparent activation energies were 16.7 kcal for the faster and 20 kcal for the slower reaction. These results were applied to remove single layer planes from graphite crystals and to measure step heights on crystals. Peculiar surface irregularities found on crystals after prolonged ozone attack were attributed to catalytic effects. (auth)

8902 SYNTHESIS AND CRYSTALLOGRAPHIC DATA OF SODIUM THORIUM TRIPHOSPHATE, $NaTh_2(PO_4)_3$, AND SODIUM URANIUM(IV) TRIPHOSPHATE, $NaU_2(PO_4)_3$. Matkovic, B. (Inst. Ruder Boskovic, Zagreb); Sljukic, M. Croat. Chem. Acta, 37: 115-16(1965).

To obtain single crystals of $NaTh_2(PO_4)_3$, a mixture of

2.5 g $Na_4P_2O_7 \cdot 10H_2O$, 1.3 g ThO_2, and 2.5 g NaCl was heated to 850°C for 24 hr in a platinum crucible. The insoluble residue, left after boiling in water, was heated again with 2.5 g $Na_4P_2O_7 \cdot 10H_2O$ and 3.0 g B_2O_3 to 1200°C for 24 hr. After this the fused mixture was cooled very slowly and then washed with acidified water. The crystals obtained were colorless, transparent monoclinic prisms, which were insoluble in all acids. Their chemical composition, determined by analysis, corresponded to the formula $NaTh_2(PO_4)_3$. To obtain single crystals of $NaU_2(PO_4)_3$, a mixture of 4.0 g $NaPO_3$, 2.7 g UO_2, and 3.0 g B_2O_3 was kept in a nitrogen atmosphere for 24 hr at 1200°C in a graphite crucible and then very slowly cooled. The crystals, separated from the solid mass by washing with acidified water, were dark green monoclinic prisms. They were soluble in a mixture of aqua regia and hydrofluoric acid. The results of complete chemical analysis were in agreement with the formula $NaU_2(PO_4)_3$. (auth)

8903 NUCLEAR DESALINATION PROSPECTS. Hitchcock, A. (Atomic Energy Establishment, Winfrith, Eng.). EuroNuclear, 2: 533-6(Nov. 1965).

Sea water desalination processes are discussed. Flash distillation, multi-effect multi-stage flash distillation, scale control in distillation, multi-effect distillation, the theory of distillation, reverse osmosis, and electrodialysis are considered. Use of nuclear reactors as heat sources in desalination is discussed. (M.C.G.)

8904 COMPLEX COMPOUNDS OF URANIUM HEXAFLUORIDE WITH SODIUM FLUORIDE AND POTASSIUM FLUORIDE. Malm, John G.; Selig, Henry; Siegel, Stanley (Argonne National Lab., Ill.). Inorg. Chem., 5: 130-2 (Jan. 1966).

The reaction of UF_6 with NaF goes to completion rapidly if the NaF is suspended in an inert solvent, C_7F_{16}. Two compounds are formed, $NaUF_7$ and Na_2UF_8. Single crystals of Na_2UF_8 were obtained. The Na_2UF_8 phase is body-centered-tetragonal with a = 5.27 and c = 11.20 Å. A model based on this symmetry and cell size led to an eightfold co-ordination of fluorine atoms around each uranium atom, with all U–F distances equivalent. The preparation of the analogous compounds KUF_7 and K_2UF_8 is also described. (auth)

8905 THE CRYSTAL STRUCTURE OF LANTHANUM TELLURIDE AND TELLURIUM-DEFICIENT NEODYMIUM TELLURIDE. Wang, R.; Steinfink, H.; Bradley, W. F. (Univ. of Texas, Austin). Inorg. Chem., 5: 142-5(Jan. 1966).

Single crystal x-ray diffraction studies of $LaTe_2$ and $NdTe_2$ and of the related tellurium-deficient compositions confirmed the isomorphism with Fe_2As(C 38). Two different types of tellurium atoms exist in the structure. The atoms in the basal plane are essentially metallic in nature and give rise to the observed electrical properties. These are the atoms that can be removed from the structure to produce the tellurium-deficient compositions. This explains the increased electrical resistivity as well as the decrease in the length of the a axis and the increase in the length of the c axis observed for these compounds. (auth)

8906 DIMORPHISM IN THORIUM TETRABROMIDE. Scaife, D. E. (Commonwealth Scientific and Industrial Research Organization, Melbourne). Inorg. Chem., 5: 162-4(Jan. 1966).

During a differential thermal analysis study of the thorium–bromine system, it was found that pure thorium tetrabromide showed a small endothermic peak at 420°C, corresponding to a heat of reaction of about 1 kcal/mole. X-ray powder photographs confirmed the existence of two forms of thorium tetrabromide stable above and below this temperature. The β (high-temperature) form consisted of well-formed uniaxial crystals with straight extinction, while the α (low-temperature) form was probably biaxial, with straight extinction. (F.J.H.)

8907 A COPRECIPITATION TECHNIQUE FOR THE PREPARATION OF THERMOLUMINESCENT, MANGANESE-ACTIVATED CALCIUM FLUORIDE (CaF_2:Mn) FOR USE IN RADIATION DOSIMETRY. Palmer, R. C.; Blase, E. F.; Poirier, V. (Edgerton, Germeshausen and Grier, Inc., Santa Barbara, Calif.). Int. J. Appl. Radiat. Isotop., 16: 737-45(Dec. 1965).

A procedure for the preparation of thermoluminescent, manganese-activated calcium fluoride (CaF_2:Mn) which involves the activation of coprecipitated mixed fluorides of calcium and manganese at 1200°C, is described. The characteristics of the material are given, and a comparison is made between the coprecipitated product and that produced by procedures described in the literature. The coprecipitated phosphor was thoroughly investigated in terms of radiation dosimetry and found to have a linear response ranging from 100 μr to at least 10^4r with an information loss of less than 3% per 2-month period. (auth)

8908 A NEW ^{32}P-LABELED COLLOID FOR MEDICAL USE. Kurcbart, H.; Radicella, R. (Comision Nacional de Energia Atomica, Buenos Aires. Univ., Buenos Aires). Int. J. Appl. Radiat. Isotop., 16: 749-51(Dec. 1965).

A ^{32}P-labeled colloid was prepared by forming iron hydroxide colloid in a solution containing carrier-free ^{32}P-orthophosphate. The colloid is autoclaved for 30 min at 120°C and then stabilized with gelatin. More than 97% of the ^{32}P is bound to the colloidal base. The proposed procedure is suitable for remotely controlled operation. The biological distribution of the colloid was studied by injecting the preparation into legs of mice. After 15 days about 80% was retained at the site of the injection. It was demonstrated that, at least in vitro, the ^{32}P bound to the colloidal base exchanges partially with inactive phosphate. (M.C.G.)

8909 PREPARATION OF HIGH-CAPACITY ARGON CLATHRATE OF HYDROQUINONE. Stottlemyer, R. R.; Diethorn, W. S. (Pennsylvania State Univ., University Park). Int. J. Appl. Radiat. Isotop., 16: 751-2(Dec. 1965).

An argon clathrate of hydroquinone was prepared with an argon content exceeding 90% of theoretical density at argon pressures as low as 500 psig by a modification of the ethyl ether solution method. About 50% of the hydroquinone is recovered in the form of clathrate. (M.C.G.)

8910 ON CERTAIN PROPERTIES OF SCANDIUM PHOSPHIDES. Komissarova, L. N.; Men'kov, A. A.; Vasil'eva, L. M. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Neorg. Mater., 1: 1493-7(Sept. 1965). (In Russian).

Methods for the synthesis and analysis of ScP were developed. Some physical and chemical properties of ScP were determined. It was established that during the heating of ScP in air noticeable oxidation begins at 350°C. The oxidation proceeds to the phosphate, which crystallizes in the tetragonal syngony with a = 6.578 ± 0.003 and c = 5.795 ± 0.005 Å. ScP is stable in water and in alkaline solutions but is decomposed easily by acids. (tr-auth)

8911 THERMODYNAMICS OF REACTIONS PRODUCING RARE EARTH HEXABORIDES. Portnoi, K. I.; Timofeev, V. A.; Timofeeva, E. N. Izv. Akad. Nauk SSSR, Neorg. Mater., 1: 1513-20(Sept. 1965). (In Russian).

The heats of formation of all rare earth hexaborides were calculated. The equations of isobaric-isothermal potentials and the equilibrium constants of formation reactions of rare earth hexaborides were calculated. It was established that the production of hexaborides of high purity is possible by borothermal reduction. (tr-auth)

8912 MAGNETIC SUSCEPTIBILITY OF THE OXIDES OF LANTHANUM, NEODYMIUM, AND GADOLINIUM. Smol'kov, N. A.; Dobrovol'skaya, N. V. (All-Union Research Inst. of Natural Resources, USSR). Izv. Akad. Nauk SSSR, Neorg. Mater., 1: 1564-5(Sept. 1965). (In Russian).

In the temperature range from 20 to 800°C the magnetic susceptibility χ of the oxides La_2O_3, Nd_2O_3, and Gd_2O_3 was investigated. The oxide La_2O_3 in all temperature ranges has the diamagnetic susceptibility $\chi_{diam} = -0.23 \times 10^{-6}$

$cm^3\ g^{-1}$. The oxides Nd_2O_3 and Gd_2O_3 are paramagnetic with χ_{para} at 20°C and with the effective magnetic moments equal to 29.5×10^{-6} $cm^3\ g^{-1}$ and 3.79 Bohr magnetons and 140×10^{-6} $cm^3\ g^{-1}$ and 7.95 Bohr magnetons, respectively. The tests results were compared with the the theoretical data of Van Vleck. (tr-auth)

8913 MAGNETIC PROPERTIES OF GADOLINIUM, DYSPROSIUM, AND HOLMIUM OXIDES AND ORTHOTANTALATES. Pinaeva, M. M.; Krylov, E. I.; Ryakov, V. M. (Ural Polytechnic Inst., USSR). Izv. Akad. Nauk SSSR, Neorg. Mater., 1: 1566-8(Sept. 1965). (In Russian).

The magnetic susceptibilities of Gd_2O_3, Dy_2O_3, Ho_2O_3, $GdTaO_4$, $DyTaO_4$, and $HoTaO_4$ were investigated in the temperature range from 291 to 1273°K. The dependence of the magnetic susceptibilities on the temperature obeyed the Curie-Weiss law well except for $GdTaO_4$, which followed the Curie law. The magnetic properties of the oxides and orthotantalates of Gd, Dy, and Ho made it possible to assign them to the class of compounds with high spin electron distribution. The orthotantalates investigated can be used as paramagnetic materials at high temperatures. (tr-auth)

8914 ON THE RELATION BETWEEN THE STRUCTURAL AND CATALYTIC PROPERTIES OF RARE EARTH COMPOUNDS. Bandurkin, G. A. (Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). Izv. Akad. Nauk SSSR, Neorg. Mater., 1: 1569-72(Sept. 1965). (In Russian).

The connection between the range of the crystallochemical instabilities in the series of rare earth compounds and the extreme values of the catalytic activity of the compounds was established. A quantitative explanation of this relation is given. (tr-auth)

8915 SYNTHESIS AND PROPERTIES OF RARE EARTH MONOALUMINATES. Portnoi, K. I.; Timofeeva, N. I. Izv. Akad. Nauk SSSR, Neorg. Mater., 1: 1598-1601(Sept. 1965). (In Russian).

By the thermal decomposition of nitric acid salts, the monoaluminates of La, Pr, Nd, Sm, and Eu were obtained at 1200°K and the monoaluminates of Gd and Dy at 1650°K. The monoaluminates of the rare earth elements have refractory properties, are stable at high temperatures, and possess high chemical stability with respect to boiling water, water at high temperatures, and some chemical reagents. (tr-auth)

8916 PHASE TRANSITIONS OF URANIUM TETRAFLUORIDE AND TETRACHLORIDE. Khripin, L. A.; Gagarinskii, Yu. V.; Luk'yanova, L. A. (Inst. of Inorganic Chemistry, Novosibirsk, USSR). Izv. Sibirsk. Otd. Akad. Nauk SSSR, No. 3, Ser. Khim. Nauk, No. 1, 13-19(1965). (In Russian).

Differential thermal analysis was used to determine the melting points of UF_4 and UCl_4 to be 1003 ± 2 and 564 ± 1°C, respectively. A polymorphous transition at 837 ± 3°C for UF_4 was found that had not been described before. The heat of transformation has a value of the order of 3.4 to 3.8 kcal/mole. In UCl_4 one polymorphous transformation was detected, occurring at 547 ± 3°C. The heat of this transformation was approximately 2.8 kcal/mole. (auth)

8917 INVESTIGATION OF THE AQUEOUS BOND IN URANIUM AND PLUTONIUM TETRAFLUORIDE CRYSTAL HYDRATES. Teterin, E. G.; Khanaev, E. I. (Inst. of Inorganic Chemistry, Academy of Sciences, Novosibirsk). Izv. Sibirsk. Otd. Akad. Nauk SSSR, No. 7, Ser. Tekh. Nauk, No. 2, 51-62(1965). (In Russian).

The infrared absorption spectra, in the range from 400 to 4000 cm^{-1}, of the crystal hydrates of uranium tetrafluoride with cubic and rhombic symmetry with light and heavy water and their dehydration products in vacuum were investigated. The infrared spectra of higher crystal hydrates of plutonium tetrafluoride of rhombic symmetry were obtained and investigated. It was established that the infrared spectra of $PuF_4 \cdot 2.3H_2O$ completely fits the infrared spectrum of the corresponding forms of the higher crystal sulfates of uranium tetrafluoride. In the makeup of the crystal hydrate of cubic symmetry water enters in the molecular form bound, to an extreme degree, by two different hydrogen bonds, one of which possibly corresponds to bonds of the type O–H ... F and the other to bonds of the type O–H ... O. In the makeup of the crystal hydrates of uranium and plutonium tetrafluorides of rhombic symmetry, water enters in the molecular form bound with some different types of bonds. The presence of weakly bound molecular water appeared characteristic for crystal hydrates of rhombic symmetry of $UF_4 \cdot 2.5H_2O$ and $PuF_4 \cdot 2.5H_2O$. It is shown that during the dehydration of the higher crystal hydrates of plutonium tetrafluoride in air near 250°C plutonium dioxide is formed. (tr-auth)

8918 FLUORIDE COMPLEXES OF PENTAVALENT PLUTONIUM. Penneman, R. A.; Sturgeon, George D.; Asprey, L. B.; Kruse, F. H. (Los Alamos Scientific Lab., N. Mex.). J. Am. Chem. Soc., 87: 5803-4(Dec. 20, 1965). (LA-DC-7488).

The preparation compounds containing pentavalent plutonium, Rb_2PuF_7 and $CsPuF_6$, is reported. Rubidium carbonate (in the 2 : 1 mole ratio of Rb : Pu) was added to Pu(IV) nitrate solution and the solution was acidified with HF. The x-ray powder pattern showed rhombohedral $7RbF \cdot 6PuF_4$ as the major phase plus some unidentified material. This mixture was placed in a nickel fluorinator and heated with fluorine gas. The product was an intense green salt. X-ray powder analysis gave a pattern free from lines of the starting material. The pattern was indexed as monoclinic, $a_0 = 6.270$, $b_0 = 13.416$, and $c_0 = 8.844$ Å (all ±0.008 Å) and $\beta = 90°$. Several of the most intense lines are given for the compound, Rb_2PuF_7 along with the calculated values. Cesium plutonium(IV) fluoride was fluorinated at 350°C overnight. The product was $CsPuF_6$. Titration of iodine liberated from a freshly prepared sample of $CsPuF_6$ showed that >90% of the plutonium was in the pentavalent state. (F.J.H.)

8919 ELECTRICAL CONDUCTIVITY STUDIES OF TETRAGONAL ZIRCONIA. McClaine, L. A.; Coppel, C. P. (Arthur D. Little, Inc., Cambridge, Mass.). J. Electrochem. Soc., 113: 80-5(Jan. 1966).

The a-c and d-c resistances for tetragonal zirconia were measured over the temperature range from 1100 to 1500°C and a pressure range of 1 to 10^{-14} atm oxygen. Polarization studies indicated that in oxygen atmospheres an oxygen electrode reaction occurs at the platinum–zirconia interface so that it is not possible accurately to separate ionic and electronic conduction components from the resistance data. However, the data did indicate a significant ionic conduction component within the pressure and temperature range studied. Assuming that oxygen transport accounts for the ionic conduction some order-of-magnitude values for oxygen diffusion in zirconia at 1400°C were calculated. (auth)

8920 KINETIC STUDIES OF FLUORINATION OF URANIUM CARBIDES BY FLUORINE. I. THE FLUORINATION OF URANIUM MONOCARBIDE. Iwasaki, Matae; Sakurai, Tsutomu; Ishikawa, Jiro (Japan Atomic Energy Research Inst., Tokyo). J. Nucl. Sci. Technol. (Tokyo), 2: 432-7(Nov. 1965).

The kinetics and the mechanism of the reaction of fluorine with UC to form UF_6 were studied in the temperature range between 240 and 300°C. (D.C.W.)

8921 ON OXYGEN ISOTOPE EXCHANGE OVER NEODYMIUM OXIDE IN VARIOUS CRYSTALLINE FORMS. Sazonov, L. A.; Ratov, A. N.; Ratova, T. G. (Inst. of Catalysis, Academy of Sciences, Siberian SSR). Kinet. Kataliz., 6: 836-41(Sept.-Oct. 1965). (In Russian).

In the temperature range from 300 to 500°C oxygen isotope exchange on neodymium oxide was investigated in the cubic and hexagonal forms and in mixtures of these two forms. For neodymium oxide in the hexagonal form the isotopic exchange of oxygen with the oxygen of the oxide was also investigated. For oxygen isotope exchange reactions, a dependence of the activity of the processing conditions of the oxide was observed in a vacuum and in

oxygen; a dependence of the activity on the composition of the crystalline form was not observed. The activation energy of the isotopic exchange was 30 kcal/mol. For the isotopic exchange reaction with the oxide oxygen the activation energy was 20 kcal/mol. (tr-auth)

8922 ON THE NATURE OF SURFACE RADIATION-INDUCED DEFECTS IN IRRADIATED SILICA GEL. II. CATALYTIC ACTIVITY OF IRRADIATED SILICA GEL IN THE ISOTOPE EXCHANGE BETWEEN HYDROGEN AND DEUTERIUM. Mishchenko, Yu. A.; Boreskov, G. K. (Karpov Inst. of Physics and Chemistry, Academy of Sciences, USSR). Kinet. Kataliz, 6: 842-8(Sept.-Oct. 1965). (In Russian).

The catalytic activity of irradiated silica gel in isotope exchange reactions between hydrogen and deuterium was investigated. The apparent activation energy and the reaction order for partition of the mixture were determined. It is shown that the activity of the samples investigated depended strongly on the percentage of aluminum impurities, the activation conditions of the samples, and the irradiation. Very fast annealing of the activity in a hydrogen atmosphere in comparison with the annealing in a vacuum was established. The relation of the change of the catalytic activity to the change of the absorptive capacity for hydrogen and to the intensity of the sextet signal in the EPR spectrum, to the changes of the Al percentage of the sample, activation conditions, radiation conditions, and annealing in vacuum and hydrogen atmosphere were established. It was concluded that along with centers of catalytic isotopic exchange in molecular hydrogen in the irradiated silica gel and with centers of hydrogen adsorption, surface color centers, connected with the Al impurities, also appear. (tr-auth)

8923 PRODUCTION OF XeF_2. Groz, Peter; Kiss, Istvan; Revesz, Andras; Sipos, Tamas. Magyar Tud. Akad. Kozp. Fiz. Kut. Int. Kozlemen., 13: 283-90(1965). (In Hungarian).

Xenon difluoride was produced by circulating a mixture of Xe and F_2 through a Monel tube reactor filled with nickel plates kept at 500°C and trapping out the product before passing back to the reaction zone. The compound was analyzed by chemical methods and mass spectrometry. It has a melting point at 130 ± 0.6°C and by optical measurements was found to crystallize in the monoclinic system. Some qualitative reactions observed on the XeF_2 are described. (auth)

8924 STUDY OF U + C → UC REACTION IN THE SOLID STATE, IN MIXED URANIUM AND CARBON POWDERS. PART I. Gregoire, P. Mem. Sci. Rev. Met., 62: 635-62(Sept. 1965). (In French).

The reaction U + C → UC takes place in two successive stages; the second corresponds to a very marked anisotropy of the dimensional changes, which is due to the texture imposed on the graphite matrix by the compression of the powders. Tests showed that there was no sintering of the uranium, but dispersion of the particles in the graphite matrix. (auth)

8925 COMPATIBILITY TESTS FOR Be–Zr–2.5 PERCENT Cu AND Be–STAINLESS STEEL 347. Champigny, L. Meny; Salauen, P. (CEN, Saclay). Mem. Sci. Rev. Met., 62: 671-82(Sept. 1965). (In French).

The compatibility between Be and Zr-2.5% Cu alloy or type-347 stainless steel between 500 and 650°C, in a vacuum, under a mechanical pressure of 30 kg/cm^2 was studied. In all cases diffusion was observed with welding. A continuous oxide deposit inhibited the diffusion. (auth)

8926 QUADRUPOLE RELAXATION IN SOLUTIONS OF ELECTROLYTES. Deverell, C.; Frost, D. J.; Richards, R. E. (Physical Chemistry Lab., Oxford). Mol. Phys., 9: 565-77(1965).

Nuclear resonance line widths are recorded for ^{79}Br, ^{81}Br, and ^{127}I in aqueous solutions of salts of the alkali metals and alkaline earth metals. The line width is determined by quadrupole relaxation and is shown to depend on bulk viscosity and on salt concentration according to an equation $\Delta\nu = A\eta + Bc\eta$, where A and B are constants. B is close to zero for strongly hydrated ions, but significant for K^+, Rb^+, and Cs^+. At very high concentration the equation no longer holds. (auth)

8927 NITRIDE HALOGENIDES OF THORIUM AND URANIUM. Juza, Robert; Sievers, Rolf (Univ., Kiel). Naturwissenschaften, 52: 538(1965). (In German).

After ammonolysis of $ThCl_4$ between 650 and 1100°C in an ammonia current, a product was obtained that was identified as ThNCl. This compound has a layer lattice and crystalizes in the PbFCl type. The nitride halogenides ThNBr and ThNI were prepared by conversion of Th_3N_4 with halogen or with thorium tetrahalogenide. Uranium tetrachloride reacts with a mixture of uranium nitrides with the formation of UNCl, which is analogous to the Th compounds with the PbFCl-type lattice. (J.S.R.)

8928 RADIOMETRIC DETERMINATION OF ION SELF-DIFFUSION MOBILITIES. III. POLYION SELECTIVITY IN SOLUTIONS. Dorabialska, Alicja; Plonka, Andrzej (Technical Univ., Lodz, Poland). Nukleonika, 10: 331-5(1965).

Sodium and cesium transfer rate coefficients were measured in mixed solutions of heparin sodium salt and cesium chloride. Variations of the ion exchange equilibrium quotient were dependent on the ion concentration ratio. There was no evidence of polyion specific affinity. (auth)

8929 ELECTROLYTIC OXIDATION OF CERIUM(III) TO CERIUM(IV). Kohman, Lucja; Perec, Mieczyslaw. Przemysl Chem., 44: 239-43(May 1965). (In Polish).

Electrolytic oxidation of cerium(III) to cerium(IV), in ~3 to 6M HNO_3 solutions in the presence of rare earths and in pure solutions of cerous nitrate, was examined. The normal redox potential, determined in the system Ce (III) to Ce(IV), was +1.27 v, in relation to a saturated calomel electrode. Depending on the concentration of cerium, electrolysis, carried out at constant current density in the range from 0.48 to 2.54 amp/dm^2, occurred with a current yield of 62 to 56% for 100% cerium oxidation. The energy consumption was between 0.95 and 2.30 erg/g Ce(IV), depending on the current density used. Electrolysis of the same solutions, carried out at a controlled anode potential, occurred with current yield of 90 to 98% for 100% cerium oxidation. Energy consumption was ~0.8 erg/g Ce(IV). (auth)

8930 POWDERED CYCLOTRON TARGETS FOR STACKED FOIL ACTIVATION EXPERIMENTS. Natowitz, J. B.; Pement, F.; Wolke, R. K. (Univ. of Pittsburgh). Rev. Sci. Instrum., 37: 121-2(Jan. 1966).

A single, quantitative, and universally applicable method of preparing powered cyclotron targets for stacked foil experiments is described. The method is an adaptation of the standard radiochemical technique of mounting radioactive precipitates for counting. The technique was checked by comparing excitation functions obtained through their use with excitation functions obtained in other ways. (L.B.S.)

8931 TUNGSTEN DIBORIDE: PREPARATION AND STRUCTURE. Woods, H. P.; Wawner, F. E. Jr.; Fox, Barbara G. (Texaco Experiment Inc., Richmond, Va.). Science, 151: 75(Jan. 7, 1966).

Tungsten boride was prepared and assigned the formula WB_2. The assignment is based on comparison of the x-ray diffraction data of this boride with those of diborides of the AlB_2 type structure. Values of $a_0 = 3.02$ and $c_0 = 3.05$ were calculated for a hexagonal unit cell. (auth)

8932 SUBSOLIDUS STRUCTURE OF A HEXACOMPONENT SYSTEM $MgO–Cr_2O_3–Al_2O_3–ZrO_2–TiO_2–SiO_2$. Berezhnoi, A. S.; Gul'ko, N. V. (Ukrainian Inst. of Refractory Materials, USSR). Ukr. Khim. Zh., 31: 881-7 (1965). (In Russian).

The subsolidus structure of $MgO–Cr_2O_3–Al_2O_3–ZrO_2–TiO_2–SiO_2$ was studied. The complexity of this system is reflected in occurrence of 99 conoids between the neighboring phases. The distribution of conoids according to the

number of crystal spacings corresponding to a concentrated hexatrope of the $MgO-Cr_2O_3-Al_2O_3-ZrO_2-TiO_2-SiO_2$ system is shown. The dependence of the logarithm of the average number of elemental polytropes in subsystems of this hexacomponent system on the number of these polytropes is shown. It was found that in the $MgO-Cr_2O_3-Al_2O_3-ZrO_2-TiO_2-SiO_2$ systems, there cannot be stable phases composed of more than 3 pure components. The dependence of the maximum and minimum melting temperatures of crystalline phases and of the melting temperature of the lowest melting eutectic among the subsystems of the hexacomponent system $MgO-Cr_2O_3-Al_2O_3-ZrO_2-TiO_2-SiO_2$ on the number of subsystems or phases was determined. (CFSTI)

8933 THE EFFECT OF PRE-TREATMENT ON THE HETEROGENEOUS ISOTOPE EXCHANGE AT THE SURFACE OF ION CRYSTALS AND THE FORMATION OF CATION AND ANION BODIES. Guetlich, Ph.; Lieser, K. H. (Technische Hochschule, Darmstadt, Ger.). Z. Phys. Chem., 46: 216-28(Aug. 1965). (In German).

The effect of oversaturation, the precipitation and aging temperature, and pretreatment with barium ions or sulfate ions on heterogeneous isotope exchange at the surface of barium sulfate was investigated. The specific surface was determined by BET measurements. In precipitation from 0.1M solutions, the concentration of the exchanging ions at the surface was only half as large as in the precipitation from 0.001M solutions. With increasing precipitation and aging temperature, the concentration of the exchanging cations (c_0^+) and anions (c_0^-) at the surface of preparations obtained from 0.1M solutions increased. For the ratio $c_0^+ : c_0^-$, the value 1.5 was found at equivalent bodies. At proportionally low excess of barium or sulfate ions in the solution, cations or anions were formed. The values for c_0^+ or c_0^- increased with the concentration of the excess cations or anions in the solution. (tr-auth)

8934 STABILITY OF COMPLEX COMPOUNDS OF CATIONS OF CALCIUM AND SCANDIUM SUBGROUPS. Kumok, V. N.; Serebrennikov, V. V. (Tomsk State Univ., USSR). Zh. Neorg. Khim., 10: 2019-22(Sept. 1965). (In Russian).

The parameters a and b were found in the correlation relation $\log \beta_{ML} = a \log \beta_{LaL} + b$; $\log \beta_{RL} = a \log \beta_{BaL} + b$ ($M^{3+} = Y^{3+}$ and Sc^{3+} and $R^{2+} = Sr^{2+}$ and Ca^{2+}), and $\log \beta_{BaL} = a \log \beta_{LaL} + b$. It is shown that the parameter a_{ij} is equal to the ratio of the ion potentials z_i/r_{iw} and z_j/r_{jw} of the ions bound with the correlation ratio plus the correction for the effect of extra stabilization in ligand field for ions with unfilled f shells. (tr-auth)

8935 BAND SPLITTING IN THE ABSORPTION SPECTRA OF NEODYMIUM AND EUROPIUM COMPLEXES DURING COMPLEX FORMATION. Ternovaya, T. V.; Kostromina, N. A. Zh. Neorg. Khim., 10: 2023-9(Sept. 1965). (In Russian).

Splitting of the ground level of $Nd(^4I_{9/2})$ and of excited levels of $Eu(^5D_2)$ during complex formation in aqueous solutions was investigated. From the number of sublevel splittings it was established that aqueous ions and complexes with EDTA have tetragonal symmetry and complexes with NTA and DTPA have trigonal symmetry. The probable structural formulas for the complexes are given. (tr-auth)

8936 BINARY LANTHANUM, CERIUM, PRASEODYMIUM, AND NEODYMIUM CHLORIDES WITH DIMETHYLAMINE CHLORIDE. Sakharova, N. N.; Avdeev, V. P. (Saratov State Univ., USSR). Zh. Neorg. Khim., 10: 2030-5(Sept. 1965). (In Russian).

The possibility of forming binary lanthanum, cerium, praseodymium, and neodymium chlorides with dimethylamine chloride in the presence of 96% ethyl alcohol was studied. Twenty binary chlorides were obtained and characterized. They had the composition $MeCl_3 \cdot x(CH_3)_2NH \cdot HCl \cdot 2H_2O$ in which Me is a rare earth element and x = 1,2,4,6, or 7. In the presence of ethyl alcohol La, Ce, Pr, and Nd chlorides easily formed complex compounds of the binary salt type with dimethylamine chloride. A method is proposed for obtaining these binary chlorides. (JPRS)

8937 REACTIONS OF RARE EARTH OXIDES WITH CHROMIUM. Portnoi, K. I.; Timofeeva, N. I.; Fadeeva, V. I. Zh. Neorg. Khim., 10: 2041-3(Sept. 1965). (In Russian).

The reactions of rare earth oxides with chromium (III) oxide and with metallic chromium was investigated in a wide concentration interval as a function of the conditions for powder sintering. Samarium and europium oxides were used. Phase diagrams of the systems of Eu_2O_3 and Sm_2O_3 with Cr_2O_3 are shown. The phase compositions in the $Cr-Sm_2O_3$ system were tabulated. (J.S.R.)

8938 REACTIONS OF LANTHANUM CHLORIDES WITH SAMARIUM AND YTTRIUM CHLORIDES. Korshunov, B. G.; Drobot, D. V.; Durinina, L. V. (Moscow Inst. of Fine Chemical Technology). Zh. Neorg. Khim., 10: 2120-3(Sept. 1965). (In Russian).

Reactions in the $LaCl_3-SmCl_3$ and $LaCl-YCl_3$ systems were studied by differential thermal analysis. In the $LaCl_3-SmCl_3$ system the components form a continuous series of solid solutions. The maximum on the liquidus curve corresponds to a molar content of 88% LaCl and 860°C. The $LaCl_3-YCl_3$ system is a eutectic type. The eutectic point corresponds to a molar content of 25% of $LaCl_3$ and 650°C. The solidus line of the $LaCl_3-SmCl_3$ system can be calculated. The points of the calculated and experimental maxima are in satisfactory agreement. The eutectic system $LaCl_3-YCl_3$ was calculated. A satisfactory correlation of the calculated and experimental curves was obtained. Apparently the crystal structure of the initial rare earth element trichlorides is a factor that determines the difference in the types of the melt diagrams of the $LaCl_3-SmCl_3$ and $LaCl_3-YCl_3$ systems. (JPRS)

8939 SYSTEMS OF FLUORIDES OF SODIUM, POTASSIUM, AND LANTHANUM. Bukhalova, G. A.; Babaeva, E. P.; Khliyan, T. M. Zh. Neorg. Khim., 10: 2127-31 (Sept. 1965). (In Russian).

In the binary system $NaF-LaF_3$ the incongruently melting compound $NaLaF_4$ is formed. The eutectic contains 29% LaF_3 at 725°C and the transition point is at 785°C with 36% LaF_3. In the binary system $KF-LaF_3$ the compound $KLaF_4$ melts incongruently at 746°C. The transition point is at 34.5% LaF_3. The eutectic corresponds to 22% LaF_3 at 625°C. In the solidus at 540°C the compound K_3LaF_6 is probably formed. The fusion diagrams of the ternary systems Na^+, K^+, La^{3+} || F^- were investigated. The eutectic with the composition 17% LaF_3, 25% NaF, and 58% KF was formed at 563°C. At the eutectic point the field of crystallization of NaF and KF and the field of the solid solutions $NaLaF_4$ and $KLaF_4$ converged. (tr-auth)

8940 THERMAL STABILITY OF $EuSO_4$. Sklyarenko, Yu. S.; Stroganova, N. S.; Ivanov, V. I. (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Academy of Sciences, USSR). Zh. Neorg. Khim., 10: 2209-14(Oct. 1965). (In Russian).

The thermal decomposition of $EuSO_4$ was studied by thermogravimetric methods. The products formed during the decomposition phases were identified by x-ray phase analysis and chemical analysis. It was established that the $EuSO_4$ is stable up to 550°C. Above this temperature the oxidation of Eu^{2+} to Eu^{3+} occurs and, almost simultaneously, the thermal decomposition of the compounds formed (probably $Eu_2O(SO_4)_2$) produces the oxysulfate $Eu_2O_2SO_4$. The parameters of the rhombic cell of $EuSO_4$ were determined: $a = 8.364 \pm 0.003$ Å, $b = 5.356 \pm 0.004$ Å, $c = 6.871 \pm 0.003$ Å, $v = 308$ Å^3, $z = 4$, and $\rho = 5.38$ g/cm^3 with the space group D_{2h}^{16} Pnma. These parameters differed from the data of Pauling and indicated the possibility of complete isomorphic substitution of Eu^{2+} and Sr in the sulfate. Data from the x-ray powder diagram of the oxysulfate of trivalent europium $Eu_2O_2SO_4$ are given. It is shown that this compound is formed during the thermal decomposition not only of $Eu_2(SO_4)_3 \cdot 8H_2O$ but also of $EuSO_4$. (tr-auth)

8941 THORIUM TRISULFATE COMPOUNDS. Molodkin, A. K.; Skotnikova, G. A.; Ivanova, O. M. (Kurnakov

Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). Zh. Neorg. Khim., 10: 2243-53(Oct. 1965). (In Russian).

Trisulfate complexes of thorium; $(NH_4)_2Th(SO_4)_3 \cdot 5H_2O$, $Na_2Th(SO_4)_3 \cdot (6 \text{ to } 6.5)H_2O$, $K_2Th(SO_4)_3 \cdot 4H_2O$, $Rb_2Th(SO_4)_3$, and $Cs_2Th(SO_4)_3 \cdot 2H_2O$, were prepared and some of their properties (density, index of refraction, chemical reactions, electric conductivity of aqueous solutions, and thermal stability) were investigated. The question of the coordination numbers of Th was considered. It is shown that Th has a tendency to form nona- and octa-coordinations; the possibility of variable coordination numbers is considered. (tr-auth)

8942 MECHANISM AND KINETICS OF THE CERIUM-OXALATE REACTION. Yatsimirskii, K. B.; Luzan, A. A. (Kiev State Univ. Inst. of General and Inorganic Chemistry, Academy of Sciences, Ukrainian SSR). Zh. Neorg. Khim., 10: 2268-74(Oct. 1965). (In Russian).

The dependence of the velocity of the reaction of cerium(IV) with oxalic acid in sulfuric acid medium on the concentration of both reaction components was investigated. A mechanism is proposed, according to which the reaction proceeds in three steps: the formation of intermediate external spherical complexes between the reagents; the decomposition of this complex because of the transmission of the electrons with reducing ligands to central ions across molecular water with the formation of singly charged oxalate radicals; and the reduction of unbound oxalate radicals to intermediate complexes of Ce(IV). It was found that small concentrations of the oxalic acid in the second step determines the rate of the reaction. Significant excess of oxalic acid causes conditions in which the third stage appears the slowest. Such conditions lead to a change in the reaction order of Ce(IV) and oxalic acid. The kinetic equations for the case of small and significant excess of oxalic acid were investigated and the conditions for constant reaction velocity were calculated. (tr-auth)

8943 MIXED RARE EARTH SULFOSALICYLATE COMPLEXES. Poluektov, N. S.; Mishchenko, V. T. Zh. Neorg. Khim., 10: 2275-81(Oct. 1965). (In Russian).

The reaction of rare earth elements in solutions of sulfosalicylate complexes was investigated spectrophotometrically and fluorometrically. By changes of the absorption spectra, it was found that in the pH range from 5.5 to 9.5 tetranuclear complex compounds are formed. In these compounds the element with the smallest ionic radius is related to the element with the largest ionic radius as 1:2. The formation of mixed sulfosalicylate complexes of the rare earth elements was confirmed fluorometrically by the appearance of sensitizing luminesence of Eu in the presence of Tb. (tr-auth)

8944 REACTIONS OF $EuCl_3$, $HoCl_3$, AND $ErCl_3$ WITH NaCl. Korshunov, B. G.; Drobot, D. V. (Moscow State Univ.). Zh. Neorg. Khim., 10: 2310-14(Oct. 1965). (In Russian).

The reactions in systems composed of the chlorides of Eu[III], Ho, and Er with sodium chloride solutions were investigated by thermogravimetric analysis. Melt diagrams were constructed for the systems $EuCl_3-NaCl$, $HoCl_3-NaCl$, and $ErCl_3-NaCl$. The melting of the established chemical compounds was determined by pycnometric methods. Hypotheses were made concerning the composition of the complexes in solution; the occurrence of the complexes $[RCl_6]^{3-}$ and $[RCl_5]^{2-}$, where R is rare earth, is probable. X-ray phase analyses were made of the systems RCl_3-NaCl. (tr-auth)

8945 PHYSICO-CHEMICAL PROPERTIES OF $CeCl_3-NaCl-H_2O$ AND $CeCl_3-KCl-H_2O$ SYSTEMS. Belyaev, N. N.; Tyuk, Le. Zh. Neorg. Khim., 10: 2355-8(Oct. 1965). (In Russian).

The solubility of the systems $CeCl_3-NaCl-H_2O$ and $CeCl_3-KCl-H_2O$ at 25 ± 01°C was studied. Both systems appeared to be simple eutonics with the composition 44.60% $CeCl_3$, 3.21% NaCl, and 52.19% H_2O and 44.51% $CeCl_3$, 5.01% KCl, and 50.48% H_2O (wt.%). In the system $CeCl_3-KCl-H_2O$ the compounds $KCl \cdot 3CeCl_3$, $3KCl \cdot 2CeCl_3$, and $3KCl \cdot CeCl_3$, which exist in the absence of solvents, did not crystalize from saturated solutions. The specific electric conductivity, viscosity, and density of saturated solution of the systems were determined. It is shown that the appearance of the extremum for eutonic solutions on the composition property isotherm is bound with the increase of the concentration of the eutonic solution and not with the complex formation. (tr-auth)

8946 COMPLEX FORMATION OF NEODYMIUM(III) WITH ETHYLENEDIAMINETETRAACETIC ACID IN AQUEOUS SOLUTION. Galaktionov, Yu. P.; Astakhov, K. V.; Zhirnova, N. M. (Moscow State Univ.). Zh. Neorg. Khim., 10: 2386-9(Oct. 1965). (In Russian).

The formation of a complex of Nd^{3+} with ethylenediaminetetraacetic acid was investigated by spectrophotometric methods. It was established that Nd^{3+} and EDTA form a complex with the composition 1:1, which exists, depending on the pH, in two forms: MeH_2Y^+ at pH from 1.2 to 1.8 and MeY^- at pH 1.8 and above. The interval of pH values for the predominance for both complexes was established and the acidolysis constants and stability constants were also determined. (tr-auth)

8947 MASS-SPECTROSCOPIC STUDIES OF SCANDIUM OXIDE EVAPORATION. Semenov, G. A. (Leningrad State Univ.). Zh. Neorg. Khim., 10: 2390-1(Oct. 1965). (In Russian).

The evaporation of Sc_2O_3 from tungsten extrusion chambers was investigated by mass spectrometric methods. In the mass spectrum of the vapor, in equilibrium at 2550°K with solid Sc_2O_3, ion currents of Sc^+ and ScO^+ in the ratio of 1:8 were reported. The pressure of the vapor of the monoxide was determined as a function of the temperature. The results are shown graphically and are tabulated. (J.S.R.)

8948 ANALYSIS OF DATA PERTAINING TO THE VAPORIZATION OF URANIUM CARBIDES. Alcock, C. B. (Imperial Coll., London); Eick, H. A.; Rauh, E. G.; Thorn, R. J. pp 330-5 of Carbides in Nuclear Energy. Vol. 1. Russell, L. E. (ed.). London, Macmillan and Co., Ltd., 1964.

A pressure-composition diagram for the U-C binary system was constructed which can reconcile the calorimetric and free-evaporation data for this system. It is necessary to postulate a large contribution from $UC_2(g)$ to the vaporization scheme in order to do this. Mass spectrometry and x-ray diffraction results obtained from sintered and arc cast samples are reported. These suggest that $UC_2(g)$ is a minor species in the vaporization of uranium carbides, and that the free evaporation process is not at equilibrium; hence the results should not be directly compared with thermodynamic data. (auth)

8949 DIRECT UF_6 REDUCTION TO METALLIC URANIUM. Slivnik, Joze; Smalc, Andrej; Volavsek, Bogdan; Frlec, Boris (Nuclear Inst. Jozef Stefan, Ljubljana, Yugoslovia). 13p. (In Polish). (CONF-207-15). ORINS.

From Second Yugoslavian Polish Symposium on Uranium Technology and Metallurgy, Zakopane, Poland, Sept. 1963.

Attempts in the direct reduction of UF_6 to metallic uranium are described. Metallic calcium and magnesium were used as reducing agents. During magnesium reduction uranium appeared in the form of a pyrophorous powder while calcium reduction led to uranium in compact blocks. The metallic uranium yield was 82% of the total quantity, which was not satisfactory. (JPRS)

8950 SOME RESULTS OF URANIUM OXIDE CHLORINATION STUDIES. Zado, Franjo (Inst. Rudjer Boskovic, Zagreb). 9p. (In Polish). (CONF-207-13). ORINS.

From Second Yugoslavian Polish Symposium on Uranium Technology and Metallurgy, Zakopane, Poland, Sept. 1963.

A survey was made of studies of uranium oxide chlorination. Numerous experiments were carried out to find an

appropriate method for the preparation of uranium (IV) oxychloride. The most successful chlorination method proved to be the one utilizing thionyl chloride. The results are discussed on the basis of the temperature effect of the chlorination reaction and of the quality of the uranium dioxide used. Several methods for preparation were investigated along with certain physical and chemical properties of uranium (IV) oxychloride. (JPRS)

8951 URANIUM OXIDE REDUCTION BY MEANS OF SILICON. Ban, Z.; Sikirica, M. (Inst. Rudjer Boskovic, Zagreb). 15p. (In Polish). (CONF-207-12). ORINS.

From Second Yugoslavian Polish Symposium on Uranium Technology and Metallurgy, Zakopane, Poland, Sept. 1963.

Reactions of UO_2 and certain other metallic oxides with silicon in the floating zone without containers were studied. The melted zone was produced by electron-beam bombardment. Certain phase relations in the U–Si system are explained. A method was developed for the successful use of electron beams for the study of the state diagrams of two-component and multicomponent systems with melting points above 3,000°C. (JPRS)

8952 URANIUM SALT-TO-METAL REDUCTION. Molosavljevic, Jovan (Center for Nuclear Raw Materials, Belgrade). 26p. (In Polish). (CONF-207-22). ORINS.

From Second Yugoslavian Polish Symposium on Uranium Technology and Metallurgy, Zakopane, Poland, Sept. 1963.

Results obtained during the mastering of technology for green salt production by a continuous extraction of phases using the dry approach are presented. The engineering solution for the laboratory device, which consisted of a reaction tube equipped with a special helicoidal mixer, allowed the production of good quality salts. The product yielded more than 96% crude uranium metal by the magnesium thermoprocess. Ingots were compact and could be easily separated from the slag. The crude ingot had an average impurity content that did not exceed 2.4 ppM of B equivalent. (JPRS)

8953 STUDY OF THE URANIUM DIOXIDE–TITANIUM DIOXIDE AND CHROMIUM TRIOXIDE SYSTEMS. Despotovic, Zlatko (Inst. Rudjer Boskovic, Zagreb). 9p. (In Polish). (CONF-207-20). ORINS.

From Second Yugoslavian Polish Symposium on Uranium Technology and Metallurgy, Zakopane, Poland, Sept. 1963.

The system uranium dioxide–titanium dioxide was investigated up to the temperature of 2,000°C. Results showed that there exists only a UTi_2O_6 compound identical with brannerite. The uranium dioxide–chromium trioxide system appeared within the entire phase region and for temperatures up to 2,000°C. (JPRS)

8954 CONTRIBUTION TO THE STUDY OF URANIUM DIOXIDE OXIDATION KINETICS. Stamenkovic, I.; Ristic, M. M. (Inst. for Nuclear Sciences Boris Kidric, Vinca, Yugoslovia). 17p. (In Polish). (CONF-207-19). ORINS.

From Second Yugoslavian Polish Symposium on Uranium Technology and Metallurgy, Zakopane, Poland, Sept. 1963.

Thermogravimetric studies were made of uranium dioxide oxidation in the 182 to 220°C temperature interval. The experimental results were processed from the viewpoint of the Ginstling theory, and on the basis of the theory according to which the reaction rate depends on the processes that occur at the contact surfaces of the phases. It is shown that the first stage of uranium oxidation agreed with the conclusions of the Ginstling theory. (JPRS)

8955 OPTIMUM ACTIVATOR CONCENTRATIONS IN RARE-EARTH OXIDE PHOSPHORS. Ropp, R. C. (Westinghouse Electric Corp., Bloomfield, N. J.). 11p. (CONF-650804-14). ORINS. Gmelin, AED-CONF-65-208-11.

From 5th Rare Earth Research Conference, Ames, Iowa.

The intensity of fluorescence of rare earth activators in rare earth oxide phosphors was found to be an inverse function of the degree of ground-state splitting and also of the degree of resonance energy interaction between ions within the lattice. Such phenomena probably account for the completely different optimum concentration observed for the various activators studied. (auth)

8956 PREPARATION OF SODIUM PYROPHOSPHATE (^{32}P) OF HIGH SPECIFIC ACTIVITY. Caro, R.; Radicella, R.; Rega, A. F. (Comision Nacional de Energia Atomica, Buenos Aires). pp 289-91 of Primera Conferencia Interamericana de Radioquimica. Washington, D. C.; Union Panamericana, 1965. (In Spanish).

^{32}P-labeled sodium pyrophosphate with a purity of more than 97% was obtained by heating ^{32}P-labeled disodium phosphate for 5 hr between 500 and 550°C. Under the experimental conditions tested the minimum quantity necessary to maintain a degree of purity was 15 μmole. This made it possible to prepare pyrophosphate samples of high specific activity. At room temperature the product obtained was stable in aqueous solutions at pH 8.5 to 9.8. In acid solutions its stability was less and it decomposed with the formation of phosphate. (tr-auth)

8957 FAST REACTIONS AND ELECTRICAL CONDUCTANCE. Wyatt, P. A. H. (Univ. of Sheffield, Eng. Univ. de Chile, Santiago). pp 355-6 of Primera Conferencia Interamericana de Radioquimica. Washington, D. C., Union Panamericana, 1965.

It is shown that a special conductance effect that can be attributed to the solvent in ionic solutions occurs when rapid proton exchanges take place. It is suggested that a similar conductance mechanism should also operate in an electron exchange system and that in certain cases, such as for the naphthalene-naphthalene ion system, an appreciable increase in conductance should appear when a nonionic acceptor is added to an ionic solution. Preliminary experiments did not detect this increase in conductance but experiments are continuing. (J.S.R.)

8958 ZIRCONIA SOLS. (to W. R. Grace and Co.). British Patent 1,010,020. Nov. 17, 1965. Priority date Aug. 14, 1963, United States.

A process is patented for the preparation of a hydrosol of stabilized ZrO_2 particles in which the particles of the sol consist of ZrO_2 and a stabilizing oxide that is Sc_2O_3, Y_2O_3, or an oxide of a rare earth element having an atomic number from 62 to 71 inclusive. The proportion of the stabilizing oxide is such that it forms with the ZrO_2 a single solid solution phase having a cubic structure or a tetragonal structure with a monoclinic tetragonal temperature below 10°C. The process consists of adding a base to an aqueous solution of a Zr salt and a salt of a rare earth element to coprecipitate the two metal constituents, separating the precipitate and removing the electrolytes, slurrying the precipitate in deionized water at a concentration of 10 to 80 g/l, adjusting the pH of the slurry to between 3.5 to 7, and peptizing the slurry by heating at a temperature of 60 to 100°C for at least ½ hr to form the sol. (B.L.M.)

8959 IMPROVED METHOD FOR DIRECTLY PREPARING GRANULAR URANIFEROUS MATERIAL HAVING DEFINITE PARTICLE SIZE. (to Stichting Reactor Centrum Nederland). British Patent 1,010,629. Nov. 24, 1965. Priority date May 20, 1963, Netherlands.

Improvements are patented for the process described in British Patent 919,523. The process comprises forming a homogeneous aqueous solution free or substantially free of precipitation nuclei containing nitrate ions, from 0.2 to 0.6 g/l of uranyl ions, and 110 to 200 g/l of urea; maintaining the solution at a temperature of not more than 100°C so that the uraniferous material precipitates. The improvements lie in maintaining an atmosphere of CO_2 maintained at a pressure of between 1 to 3 m of water during the agitation; and after the precipitated uraniferous material is separated from the hot liquid, it is reduced with hydrogen, and the particles are then subjected to individual sintering in an atmosphere of water-containing hydrogen to produce the granular UO_2 of uniform particle size. (B.L.M.)

8960 A PROCESS FOR THE PRODUCTION OF THORIUM OXIDE AND OF MIXED OXIDES WHICH ARE RICH IN THORIUM OXIDE. (to Pechiney Compagnie de Produits Chimiques et Electrometallurgiques). British Patent 1,012,511. Dec. 8, 1965. Priority date June 28, 1961, France.

A process for the preparation of thorium oxide or a "thorium-rich mixed oxide" (at least 90 wt % of ThO_2 and up to 10 wt % of oxide of any metal or metals of Groups II to VIII of the Periodic Table) consists of the following steps: converting thorium oxalate to the hydroxy-oxalate by treatment with aqueous ammonia, forming an aqueous suspension of the hydroxy-oxalate; heating the suspension to modify the crystalline shape of the acid-treated Th hydroxy-oxalate and if a mixed oxide is desired, adding a solution of one or more of the water soluble salts of the metal; and treating the crystals in aqueous suspension with a sufficient amount of ammonia with agitation at temperatures above room temperature to raise the pH of the suspension to a range of 6 to 9; and washing and drying the precipitate. The precipitate may then be calcined to thorium oxide or the mixed oxide. The oxides have a specific surface of from 5 m^2/g to 20 m^2/g. (B.L.M.)

8961 METHOD FOR MELTING OF HIGH-MELTING METALS AND COMPOUNDS, ESPECIALLY URANIUM MONOCARBIDE. Himmelstein, Paul; Kuehn, Horst; Wille, Werner (to EURATOM). German Patent 1,202,992. Oct. 14, 1965. Filed Aug. 11, 1964.

Uranium monocarbide was melted in an arc furnance with graphite electrode above the crucible by using carbon monoxide or a mixture of argon and carbon monoxide at a pressure of about 100 to 200 torr as a protective gas. (Gmelin Inst.)

Organic Chemistry

8962 (ANL-7029, pp 15-24) FRAGMENTATION OF HYDROCARBONS. Stanton, H. E.; Wexler, S. (Argonne National Lab., Ill.).

Measurements were made of the kinetic energy released in the fragmentation of ion-molecule complexes. The following reactions were considered; $C_2H_4^+ + C_2H_4$, $C_2H_2^+ + C_2H_4$, and $CH_3^+ + CH_4$. Results indicate that very little kinetic energy is released. (M.O.W.)

8963 (COO-1189-16) PROTON-^{13}C SPIN-SPIN COUPLING. VI. FACTORS AFFECTING $J_{^{13}CCCH}$; THE $(CH_3)_3C^{13}C$ SYSTEM. Karabatsos, Gerasimos J.; Orzech, Chester E. Jr. (Kedzie Chemical Lab., Michigan State Univ., East Lansing). [1964]. Contract AT(11-1)-1189. 14p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Proton-^{13}C coupling constants through three bonds, $J_{^{13}CCCH}$, were determined for forty-two compounds of the general structure $(CH_3)_3C$-^{13}C. The couplings ranged from 3.59-5.99 cps for sp^3 hybridized ^{13}C, and from 3.72-6.43 cps for sp^2 hybridized ^{13}C. A value of 5.38 cps was obtained for trimethylacetonitrile (sp hybridized ^{13}C). Strong nonbonded repulsions among the groups attached to the ^{13}C led to low couplings; halogen substituents on the ^{13}C led to high couplings. The data are interpreted in terms of substituent electronegativity—increase in the electronegativity of the substituent on the ^{13}C increases $J_{^{13}CCCH}$; in terms of angle and bond deformations; and in terms of positive contributions from electron-orbital and spin-dipole interactions. The possibility that conformational differences between the various compounds might be responsible for the variations in $J_{^{13}CCCH}$ was examined and rejected. (auth)

8964 (TID-22412) THE CHLORINATION OF ERYTHRO- AND THREO-3-PHENYL-2-BUTYL 2,4-DINITROBENZENESULFENATE [Thesis]. Givens, Edwin N. (Oak Ridge National Lab., Tenn.). June 1965. Contract W-7405-eng-26. 124p. Dep. mn; CFSTI $4.00 cy, $0.75 mn.

Submitted to Delaware Univ., [Newark].

The enantiomeric and racemic erythro- and threo-3-phenyl-2-butyl-1-^{14}C 2,4-dinitrobenzenesulfonates were chlorinated in both acetic acid and chloroform; the products were examined. The cleavage of the carbon-oxygen bond resulted in two fragments. The 2,4-dinitrobenzene group was found to form the sulfinyl chloride by the isolation of its pyridine derivative, 2,4-dinitrobenzenesulfinylpyridinium chloride. The 3-phenyl-2-butyl moiety was found as the chloride, acetate, and alcohol products of phenyl, methyl, and hydrogen migration. The effect of lithium perchlorate on product distribution was interpreted to show existence of ion pairs. The yields, optical properties, and carbon-14 scrambling lead to a mechanistic interpretation of the reaction. An open methyl-1-phenylethyl-carbonium ion, used to explain the separate migration possibilities, as well as front and back-side attack by anion, is proposed to be the first intermediate formed. Evidence for restricted rotation about the $C_\alpha - C_\beta$ bond in this intermediate is presented. (P.C.H.)

8965 PREPARATION OF 2-^2H- AND 2-^3H-INDOLE FROM INDOXYL, AND THE STRUCTURE OF DIACETOXYMERCURI-INDOLE. Kirby, G. W.; Shah, S. W. (Imperial Coll., London). Chem. Commun., No. 16, 381(Aug. 25, 1965).

For preparation of 2-^2H-indole, indoxyl was obtained by hydrolysis of the diacetate and purified by sublimation (100°, 10^{-4} mm). Indoxyl was shaken in chloroform with 1N DCl for 10 min at room temperature to give the 1,2,2-$^2H_3$ derivative. Reduction with excess of lithium aluminum hydride in ether at room temperature then gave 2-^2H-indole. This material, mp 49-52°, had the expected NMR spectrum. 2-^3H-Indol was prepared in a similar manner using acidified, tritiated water in the exchange reaction with indoxyl. Treatment of indole with aqueous mercuric acetate (2 moles) gave a diacetoxymercuri-indole in high yield. 2-^3H-Indole, relative molar activity (rma) 1.0, was converted in this way into the corresponding mercurated derivative (rma 0.99) which was reduced with lithium aluminum hydride in ether to regenerate indole (rma 0.97). Similarly, mercuration in ethanol gave diacetoxymercuri-indole (rma 0.92) which again was converted into indole (rma 0.88). Reduction of the mercurated indole (prepared in ethanol) with $LiAlD_4$ and decomposition of the product with water gave a mixture (ca 1:1) of indole and 3-^2H-indole. The mass spectrum showed no significant amounts of dideuterated species. These results are most simply explained if diacetoxymercuri-indole is the 1,3-dimercurated derivative, but an alternative 3,3-diacetoxymercuri-indolenine structure cannot rigorously be excluded. (BBB)

8966 PREPARATION OF RIBONUCLEOSIDE 5'-MONOPHOSPHATES-^{14}C OF HIGH SPECIFIC ACTIVITY FROM THE ALGAE CHLORELLA PYRENOIDOSA. Nejedly, Z.; Koutecky, Z.; Gruenberger, D. (Inst. for the Research, Production and Application of Radioisotopes, Prague. Inst. of Organic Chemistry and Biochemistry, Prague). Collec. Czech. Chem. Commun., 30: 3361-9 (Oct. 1965).

The algae Chlorella pyrenoidosa-^{14}C of high specific activity were prepared by photosynthesis in $^{14}CO_2$ atmosphere. The high specific activity was attained by rapid incorporation of $^{14}CO_2$ released from $Ba^{14}CO_3$ of high isotopic ratio (33 to 47%) into the algal cells. After removal of lipids, colored matter and compounds soluble in acidic medium the algae were extracted with hot 10% sodium chloride solution. High molecular nucleic acids-^{14}C were isolated from the sodium chloride extract. A mixture of nucleoside 5'-monophosphates unspecifically labeled with radiocarbon was obtained by enzymatic cleavage of the nucleic acids-^{14}C with the phosphodiesterase from snake venom. The 5'-mononucleotides-^{14}C were separated by chromatography on Dowex 1 × 2 using a formic acid gradient. Trace quantities of 5'-deoxyribonucleotides-^{14}C and other contaminants were removed from the ribonucleoside 5'-monophosphates by rechromatography. The specific activity of the isolated compounds attained values of up to 100 mC/mmol. (auth)

8967 SECONDARY HYDROGEN ISOTOPE EFFECTS. VII. ETHANOLYSIS RATES OF 1,1-DIMETHYLALLYL-3,3-d_2 CHLORIDE AND 3,3-DIMETHYLALLYL-1,1-d_2 CHLORIDE. Belanic-Lipovac, V.; Borcic, S.; Sunko, D. E. (Inst. Ruder Boskovic, Zagreb). Croat. Chem. Acta, 37: 61-5(1965).

Primary and tertiary dimethylallyl chlorides deuterated at either the alpha or gamma position were prepared and subjected to ethanolysis. A kinetic isotope effect (K_H/K_D) of 1.20 was observed in the reaction of the primary isomer, while the tertiary chloride reacted at the same rate as the undeuterated analog. The absence of an isotope effect in the latter case is explained by the lack of sp^3-sp^2 rehybridization of the carbon-deuterium bonds in the rate determining step. (auth)

8968 THE PHOTOCHEMICAL REACTION OF HYDROGEN PEROXIDE WITH ALLYL ALCOHOL-3,3-d_2. Leyshon, L. J.; Volman, D. H. (Univ. of California, Davis). J. Am. Chem. Soc., 87: 5565-68(Dec. 20, 1965).

The reaction of hydroxyl radicals, derived from the photolysis of hydrogen peroxide, with allyl alcohol-3,3-d_2 in the frozen state at 77°K and in liquid solutions in the range from 253 to 350°K was studied. An analytical method based on the gas phase reaction of water with sodium mirrors was developed. For the reaction with sodium, the isotopic separation factor for protium and deuterium in water was found to be 1.8 in the range from 0 to 35% deuterium. For all the photochemical experiments, abstraction of deuterium atoms was shown to occur with 8.4 ± 2.5% of the hydroxyl radicals formed; the remainder was considered to add to the olefinic bond. Electron spin resonance spectra of irradiated frozen samples showed that absorption of light by the deuterated allyl alcohol leads to cleavage of the carbon–oxygen bond and that the reaction of hydroxyl radicals with the alcohol is consistent with the interpretation that deuterium atoms are abstracted. (auth)

8969 LABELLING OF BETA-LIPOPROTEIN WITH TRITIUM. Gosztonyi, T.; Marton, J.; Kovacs, A. (National Atomic Energy Commission, Budapest). Nature, 208: 381-2(Oct. 23, 1965).

Beta-lipoprotein was labeled with tritium by a sample exchange reaction in radiochemically pure form, using $CH_3COOHT \cdot BF_3^+ CH_3COO^-$ as the tritiating reagent. Preliminary experiments were made on other types of organic compounds, which showed that the hydrogen atoms bonded to carbon can be replaced with tritium by this reagent. The rate of the exchange reactions was found to be markedly dependent on temperature. The advantages of the labeling method are pointed out. (L.B.S.)

8970 ^{13}C ISOTOPE EFFECTS IN THE DECARBOXYLATION OF MALONIC ACID. Zielinski, Mieczyslaw (Univ. of Warsaw). Nukleonika, 10: 337-41(1965).

Intramolecular and intermolecular ^{13}C isotope effects in the decarboxylation of malonic acid were measured on the McKinney-Nier mass spectrometer and the data obtained were compared with isotope effects reported in the literature. (auth)

8971 INELASTIC SCATTERING OF COLD NEUTRONS IN ETHYL ETHER NEAR THE CRITICAL POINT. Bata, L.; Koszo, E.; Kroo, N.; Pal, L. (Central Research Inst. for Physics, Budapest). Phys. Lett., 19: 15-16 (Sept. 15, 1965).

The incoherent neutron scattering properties of ethyl ether were studied near the critical temperature. A quasi-elastic spectral peak was observed at the critical point, but was not observed at temperatures very near to the critical point. It was also observed that the slope of the high-energy and of the inelastic part of the spectrum at T_c is higher than that below and above the critical point. (G.O.Y.)

8972 FREE RADICALS FORMED BY HYDROGEN ATOM BOMBARDMENT OF THE NUCLEIC-ACID BASES. Herak, Janko N.; Gordy, Walter (Duke Univ., Durham, N. C.). Proc. Nat. Acad. Sci. U. S., 54: 1287-92(Nov. 1965).

Proof was obtained that free hydrogen atoms combine directly at room temperature with ring carbons of adenine and guanine, thymine, and uracil. Samples were subjected to a beam of low-velocity hydrogen atoms produced by dissociation of molecular hydrogen by an electric discharge. The free radicals were observed and identified by their ESR patterns. The same procedure was carried out using deuterium atoms instead of hydrogen atoms. The ESR spectra of hydrogen- and deuterium-bombarded nucleic-acid bases and the proton coupling observed for free radicals are given. (F.J.H.)

8973 PRELIMINARY STUDY ON THE MECHANISM OF THE REACTION OF FORMATION OF HIPPURAN-^{131}I. Horiuchi, K.; Behrens, H. (Laboratorio de Radioquimica, Montevideo). pp 273-9 of Primera Conferencia Interamericana de Radioquimica. Washington, D. C.; Union Panamericana, 1965. (In Spanish).

The labeling reaction for Hippuran-^{131}I was studied using paper chromatography for analysis of the reaction products. The effects of pH, light, temperature, variable concentrations of Hippuran, iodine, and iodate are discussed. The relation of the reaction velocity to the temperature and light was considered. (J.S.R.)

8974 PREPARATION OF L-THYROXIN LABELED WITH ^{131}I. Servian, J. L. (Facultad de Quimica, Montevideo). pp 293-6 of Primera Conferencia Interamericana de Radioquimica. Washington, D. C., Union Panamericana, 1965. (In Spanish).

In order to prepare thyroxine labeled with ^{131}I, labeling methods proposed in the literature were reviewed. The problem of detection and determination was studied and the techniques for labeling and purification were investigated. The efficiency of various solvents for paper chromatographic separation of thyroxine was investigated. A technique for the preparation of low specific activity is given. (J.S.R.)

8975 PREPARATION OF COMPOUNDS LABELED WITH ^{131}I AT THE NATIONAL ATOMIC ENERGY COMMISSION OF ARGENTINA. Mitta, A. E. A.; Camin, L. L. (Comision Nacional de Energia Atomica, Buenos Aires). pp 297-300 of Primera Conferencia Interamericana de Radioquimica. Washington, D. C., Union Panamericana, 1965. (In Spanish).

The techniques used for the routine preparation of iodoalbumin-^{131}I, sodium o-iodohippurate-^{131}I, rose bengal-^{131}I, oleic acid-^{131}I, and triolein-^{131}I are reported. (J.S.R.)

8976 PHARMACEUTICAL CONTROL OF RADIOACTIVE COMPOUNDS AT THE NATIONAL ATOMIC COMMISSION OF ARGENTINA. Recchi, N. V. (Comision Nacional de Energia Atomica, Buenos Aires). pp 307-10 of Primera Conferencia Interamericana de Radioquimica. Washington, D. C., Union Panamericana, 1965. (In Spanish).

Routine physical, chemical, and biological tests made to ensure the radiochemical purity of pharmaceuticals are outlined. The techniques used to measure the radiochemical yield and purity are outlined. A tabulation is given of the compounds routinely prepared, the techniques used in their preparations, and the permissible impurity limits. (J.S.R.)

8977 SYNTHESIS OF STEARIC ACID-1-^{14}C. Baret, C.; Mitta, A. E. A.; Pichat, L. (Centre d'Etudes Nucleaires de Saclay, France). pp 311-14 of Primera Conferencia Interamericana de Radioquimica. Washington, D. C.; Union Panamericana, 1965. (In Spanish).

Commercial n-heptadecyl bromide was purified by gas chromatography to a purity of 98.5%. The Grignard reaction was then carried out and the product was carbonated with $^{14}CO_2$. Stearic acid was separated and purified using a polyethylene column. (J.S.R.)

Radiation Chemistry

See also BIOLOGY AND MEDICINE — Radiation Effects on Biochemicals Radiation Effects on Tissues

Refer also to abstract 9063.

8978 (AERE-M-1663) RADIOLYSIS OF MIXTURES OF CARBON DIOXIDE WITH ^{14}C LABELLED METHANE. Dominey, D. A. (Atomic Energy Research Establishment, Harwell (England)). Nov. 1965. 10p. Dep. BIS $0.50. HMSO 2s. 6d.

Mixtures of 0.49% $^{14}CH_4$ in CO_2 were irradiated at 350°C in a spent fuel element gamma source. The carbon-14 contents of the products were measured by gas chromatography and an associated gas scintillation counter. ^{14}CO, $^{14}CO_2$, $^{14}C_2H_6$, and other unidentified products containing up to 15% of the total carbon-14 were produced. About one sixth of the CO produced was derived from methane. $^{14}CO_2$ production from ^{14}CO appeared to be only slightly inhibited by the presence of CH_4. (auth)

8979 (BNWL-36) HANFORD RADIOLOGICAL SCIENCES RESEARCH AND DEVELOPMENT ANNUAL REPORT FOR 1964. Pearce, D. W.; Green, J. K. (eds.) (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Jan. 1965. Contract AT(45-1)-1830. 571p. Dep. mn; CFSTI $8.71 cy, $2.50 mn.

Developments in atmospheric physics, radiological physics, radiological chemistry, chemical effluents technology, and instrumentation are reported. Approximately 110 papers or abstracts are included. (P.C.H.)

For abstracts of individual sections see: 8817, 8980, and 9165–9167.

8980 (BNWL-36, pp 3.1-122) RADIOLOGICAL CHEMISTRY. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Research was performed in five areas of radiological chemistry: radiation chemistry; radioanalytical methods; reactor studies; counting studies; and environmental studies. Progress in radiation chemistry is reported on: radioinduced swelling and hemolysis of red blood cells; radiation protection of aqueous jellies; radiation chemistry of Erioglaucine in frozen aqueous solution; yield of p-nitroaniline radicals formed in irradiated aqueous solutions; comparison of radicals formed by gamma irradiation and dithionite reduction of aromatic nitro compounds in water; kinetics of diffusion through human erythrocyte membranes; and development of apparatus and techniques for pulsed radiolysis. Radioanalytical methods were reported for: ^{137}Cs in Alaskan Eskimo hair; separation of ^{90}Sr from hair; the radiochemical determination of plutonium in soil; rapid determination of plutonium in urine; application of tertiary amine extraction to the determination of uranium in biological materials; the direct measurement of radionuclides in bioassay samples by multidimensional gamma-ray spectrometry; the determination of rare earth and yttrium radionuclides in reactor effluent water by use of multidimensional gamma-ray spectrometry; and evaluation of radiochemical methods for radiological purposes. Reactor studies included the effect of water treatment chemicals and pH on reactor effluent radioisotope concentrations and removal of fission products from contaminated water by flocculation methods. Counting studies were made of: anticoincidence shielded-multidimensional gamma-ray spectrometry for high sensitivity analysis of radionuclide mixtures; an anticoincidence shielded-multidimensional gamma-ray spectrometer; a high-resolution lithium-drifted germanium gamma-ray spectrometer; and large area alpha ray spectrometry. Environmental studies are presented on: airborne-radionuclide measurements and physical characteristics determinations; physical and chemical characteristics of various fallout radionuclides; air concentrations of short-lived radionuclides resulting from 1964 Chinese detonation; measurement of airborne radionuclides in Alaska; ^{22}Na and ^{134}Cs in fallout, foods, and people; air concentrations of 12 radionuclides from 1962 through mid-1964; ^{110m}Ag in the atmosphere; determination of Columbia River flow times using radioactive tracers introduced by the Hanford Reactors; behavior and transport of radionuclides in the Columbia River between Hanford and the ocean; scouring of radionuclides deposited with Columbia River sediments during the spring freshet; the mechanism of retention of radionuclides in Columbia River sediments; distribution of sediments and associated radionuclides in the Columbia River below Hanford; measurement of a large group of radionuclides in Columbia River aquatic organisms; ^{131}I measurements in large volumes of Columbia River water; collection of radioisotopes from river and sea water by various materials; a comparison of the ratios of ^{136}Cs to ^{137}Cs and $^{140}Ba-^{140}La$ to ^{136}Cs from ^{235}U and ^{239}Pu fission; ^{36}Cl and ^{35}S produced by cosmic radiation; washout using natural tracers from radiochemical separations plant stacks; fluorescein as a dual atmospheric tracer; and inert atmospheric tracers as ^{133}Xe. A bibliography is included of 86 papers published during the contract period. (H.G.D.)

8981 (CEA-R-2794) ETUDE DES EFFETS DE CERTAINS ABSORBEURS DE NEUTRONS EN SOLUTION SUR LA RADIOLYSE DE L'EAU [Theses]. (Study of Effects of Certain Neutron Absorbers in Solution on the Radiolysis of Water [Thesis]). Rozenberg, Jean (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1965. 48p. Dep. mn.

Submitted to Paris Univ. (France). Faculte des Sciences.

The initial yield of molecular hydrogen formed by radiolytic decomposition of water in reactor and ^{60}Co gamma radiation was decreased by the presence of salts of polyvalent elements possessing only one stable valence, e.g., cadmium, zinc, magnesium, and gadolinium. This effect is favorable for the use of cadmium and gadolinium as soluble neutron absorber in heavy water reactors. Cations of these salts are not inert toward the primary products of water radiolysis. They have a high degree of reactivity toward the hydrated electron, which is the precursor of molecular hydrogen in neutral or alkaline aqueous media. The value of the rate constant for the reaction between cadmium ion and hydrated electron was found to be $(6.1 \pm 1.8)\ 10^{10}\ \underline{M}^{-1}\ s^{-1}$. Boric acid at low concentration has no effect on the radiation chemistry of water. An isotope effect was found in the radiolysis of heavy water, corresponding to a lowering of initial yield $[G_0(D_2) < G_0(H_2)]$. It was necessary to determine the influence of organic impurities, remaining after the purification of water, on the mechanism of its radiolytic decomposition. (auth)

8982 (ORNL-3830, pp 233-5) IRRADIATION EFFECTS ON HETEROGENEOUS SYSTEMS. (Oak Ridge National Lab., Tenn.).

The radiolysis of water adsorbed on silica gel was investigated in an attempt to determine whether or not energy transfer from the gel to the adsorbed water took place. $G(H_2)$ values as a function of water coverage were measured and found to be greater than the value for pure water, indicating either energy transfer or sensitization of the adsorbed water. (auth)

8983 (TID-22421) EXPERIMENTAL EFFECTS OF PILE RADIATION ON PURE FLUOROCARBONS. Final Report. Reed, T. M.; Mailen, J. C.; Askew, W. C. (Florida Univ., Gainesville. Engineering and Industrial Experiment Station). Sept. 14, 1965. Contract AT(40-1)-2846. 110p. Dep. mn; CFSTI $4.00 cy, $0.75 mn.

Samples of pure fluorocarbons were irradiated and then analyzed by three-column gas chromatography. Mixtures of $CF_4-C_2F_6$ and CF_4 with CO, carbon granules, and aluminum powder were also irradiated. The total G values for the destruction of F-alkanes were considerably less than those of the analogous hydrocarbons, especially for the lower members, CF_4, F_2F_6, and C_3F_8. An exception is the highly branched structure, F-2,3-dimethylbutane, which has a G_{total} of magnitude similar to those of the

hydrocarbon alkanes. The primary reason for this difference from hydrocarbons is the low probability for fluorine abstraction reaction due to the low energy of dissociation of the fluorine molecule. All of the identified products of the radiolysis of the $CF_4-C_2F_6$ mixtures are explained by a free radical mechanism. Data are tabulated. (P.C.H.)

8984 THE REACTION OF IONS IN THE RADIOLYSIS OF n-BUTANE IN THE GAS PHASE. Miyazaki, Tetsuo; Shida, Shoji (Tokyo Inst. of Tech.). Bull. Chem. Soc. Jap., 38: 2114-18(Dec. 1965).

The effect of ammonia in the radiolysis of n-butane was investigated. In low-pressure radiolysis, C_3H_8 and C_2-products decreased on the addition of ammonia, while C_3H_6 increased. C_4H_8 increased sharply on addition of a small amount of ammonia, but it gradually decreased on further addition. CH_4 and H_2 were not significantly affected by ammonia. These results were interpreted in terms of the proton transfer reaction of ammonia with ions, and their rate constants were estimated. The contribution of the excited ion to the C–C rupture was concluded to be more important than that of the excited molecule in low-pressure radiolysis. In high-pressure radiolysis all the products from the C–C rupture, including CH_4, decreased on the addition of ammonia (or water). (auth)

8985 THE EFFECT OF IONIZING RADIATIONS ON THE ADSORPTION RATE OF HYDROGEN ON MANGANESE DIOXIDE. Titani, Toshizo; Kiyoura, Tadamitsu (Tokyo Metropolitan Univ.). Bull. Chem. Soc. Jap., 38: 2196-7(Dec. 1965).

Manganese dioxide was prepared and the surface area measured to be $10 m^2/g$. Samples of the oxide were irradiated in a swimming pool reactor and with ^{60}Co γ rays in the presence of air. The oxide was placed in the adsorption apparatus; after it was evacuated at 100°C for 1 hr the temperature of the apparatus was raised and kept constant at 175, 200, or 250°C, respectively, and 1.6 ml (NTP) of hydrogen gas was introduced. The adsorption rate constants under various conditions are given. The adsorption rate of hydrogen on manganese dioxide was decreased by preirradiation of the oxide with ionizing radiation. The decrease was especially significant in the case of reactor irradiation. (F.J.H.)

8986 THE TRANSIENT ABSORPTION OF IRRADIATED α-METHYLSTYRENE. Katayama, Meiseki (Hokkaido Univ., Sapporo, Japan). Bull. Chem. Soc. Jap., 38: 2208(Dec. 1965).

A new transient absorption was observed at 5461 Å in dried α-methylstyrene by means of pulse radiolysis. An electron linear accelerator was used to produce a 1.6-μsec pulse of radiation. The photoelectric method was emplayed for recording the absorption. All the measurements were conducted at 15°C. The decay of absorption in dried α-methylstyrene at 5461 Å and the first-order plot of the decay of the absorption at 5461 Å are given. Results supported the proposed anion radical mechanism for radioinduced polymerization of α-methylstyrene. (F.J.H.)

8987 ON THE ISOTHERMAL DECAY OF TRAPPED ELECTRONS FORMED IN A RIGID γ-IRRADIATED MEDIUM. Tsujikawa, Hideo; Fueki, Kenji; Kuri, Zenichiro (Nagoya Univ., Japan). Bull. Chem. Soc. Jap., 38: 2210 (Dec. 1965).

The trapped electrons formed by γ-irradiation of organic glasses were studied. The decay constant of trapped electrons in MTHF (2-methyltetrahydrofuran) as a function of the ion-pair separation distance is shown. The tunneling of an electron from an electron-trapping center to a positive hole in MTHF was calculated. It was concluded that this tunneling is a possible mechanism for the isothermal decay of trapped electrons. (F.J.H.)

8988 PHOTOLYSIS AND RADIOLYSIS OF SOME SIMPLE NITROALKANES. I. NITROMETHANE. Paszyc, Stefan. (Univ., Poznan, Poland). Bull. Soc. Amis Sci. Lett. Poznan, Ser. B, 18: 5-17(1965).

Prolonged photolysis of nitromethane in both the vapor and liquid states, with simultaneous photolysis of the evolving nitrogen dioxide to atomic oxygen and nitric oxide was investigated. Photolysis of the compound in vapor state was conducted in a specially assembled apparatus using a quartz immersion lamp with the full range of both the visible and ultraviolet spectrum especially rich in radiation of wavelengths 366 and 313 mμ. The products of photolysis were detected by recording the infrared spectra and by gas chromatography. Apart from those investigations, photolysis of nitromethane in the presence of cupric oxide and zinc oxide was also conducted. Based on these findings and studies, a mechanism yielding the products resulting from the photochemical decay of the compound is proposed. Liquid nitromethane was also exposed to ^{60}Co γ radiation and a number of products of this radiolysis were obtained. A probable mechanism of their formation is proposed. (auth)

8989 ON THE STRUCTURE AND PROPERTIES OF POLYAMIDES. XXIII. EPR SPECTRA OF POLYAMIDES IRRADIATED BY IONIZING RADIATION. Ulbert, K. (Inst. of Macromolecular Chemistry, Prague). Collec. Czech. Chem. Commun., 30: 3285-93(Oct. 1965).

EPR spectra of polyamides and of some model substances irradiated at –196°C by γ rays and at 25°C by high frequency discharge were measured and changes of spectra at gradual tempering were observed. The changes of almost all polyamides showed a general common trend and may be interpreted by a superposition of the spectra of the two radicals $NH-\dot{C}H-CH_2$ and $-\dot{C}(OH)-$. (auth)

8990 PARAMAGNETIC RESONANCE IN GAMMA-IRRADIATED THIOSULPHATE AT 77 deg K. Mahadevappa, D. S.; Eager, R. L. (Univ. of Saskatchewan, Can.). Current Sci., 34: 691-2(Dec. 20, 1965).

The EPR spectra of gamma-irradiated $Na_2S_2O_3 \cdot 5H_2O$ and $Na_2S_2O_3$ at 77°K were obtained. The samples were irradiated to a total absorbed dose of 3×10^6 rads. The irradiated compounds appeared deeply colored at 77°K. No change in coloration took place on warming to –160°C, but there was a rapid change in color when the samples were warmed to room temperature. The greenish-brown hydrate became brown and the violet $Na_2S_2O_3$ was bleached. It was concluded from the EPR spectra that there are two kinds of magnetic centers trapped in the matrix at low temperature. (M.C.G.)

8991 RADIOLYSIS OF SOLID SOLUTIONS OF STABLE RADICALS IN ISOPROPYL ALCOHOL. Tikhomirov, L. A.; Buben, N. J. (Inst. of Chemical Physics, Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 163: 414-17 (July 11, 1965). (In Russian).

The kinetics of annihilation of stable free radicals of 2,2,6,6-tetramethylpiperidine hydroxylamine in frozen isopropyl alcohol irradiated with 1.6-Mev electrons at 100°K were studied. The concentration of these radicals and of the alcohol radicals was followed by means of electron spin resonance spectra in the course of the irradiation, and the dependence of the radical concentration on the radiation dose was studied. The disappearance of the stable radicals was found to obey the law $N_1 = N_0 e^{-k_1 D}$, where D is the dose and K_1 is a constant. The accumulation of the alcohol radicals follows the relation $N_2 = N_{2lim} [1 - e^{-k_2 D}]$, where N_{2lim} is the limiting concentration of alcohol radicals and K_2 is a constant. By use of mass spectrometry, the yields of molecular hydrogen during irradiation of pure isopropyl alcohol and isopropyl alcohol containing 3×10^{20} radicals/g at 100°K were compared; this yield was 25% lower in the latter case. It is shown that not more than 25% of all the stable radicals annihilated during radiolysis react with atomic hydrogen formed by the irradiation. In solid solutions, the stable radicals were annihilated with a very high radiation yield (240 radicals per 100 ev of energy absorbed by the radicals). The constants k_1 and k_2 were found to be equal. This means that the probability of annihilation of the stable radicals is the same as for alcohol radicals during their accumulation. The probability of annihilation of a radical by radiation is 250 times greater than the crea-

tion of a new radical. This is attributed to the transfer of energy by the solvent. (CFSTI)

8992 RADIATION CHEMICAL CARBOXYLATION OF HYDROXY COMPOUNDS. **Guetlbauer, F.; Getoff, N. (Oesterreichische Akademie der Wissenschaften, Vienna). Int. J. Appl. Radiat. Isotop., 16: 673-80(Dec. 1965). (In German).**

The radioinduced carboxylation of aliphatic and aromatic hydroxy-compounds in aqueous CO_2 solutions was thoroughly studied and its dependence on radiation dose and pH determined. As a model substance a 0.1M solution of methyl alcohol as well as solutions of phenol of varying concentrations (10^{-4} to 10^{-1} M) were used. The products of carboxylation formed were glycolic acid and p- as well as o-hydroxybenzoic acid (salicylic acid), respectively. The yield of glycolic acid under optimal conditons (pH = 4 to 6) was G(glycolic acid) = 2.1, whereas the values of G(salicylic acid) were found to be 0.5 at the best. Furthermore, α-hydroxyvaleric acid was obtained as a carboxylation product from n-butanol. To explain the radioinduced carboxylation process a reaction mechanism was proposed. (auth)

8993 GASEOUS PRODUCTS FROM INTERACTIONS OF RECOIL ^{11}C ATOMS WITH LIQUID HYDROCARBONS. **Clark, Donald E.; Voigt, Adolf F. (Ames Lab., Ames, Iowa). J. Am. Chem. Soc., 87: 5558-65(Dec. 20, 1965). (IS-1188).**

The chemical behavior of recoil carbon-11 in different types of C_5-C_7 hydrocarbons was investigated by determining the radiochemical yields of gaseous products containing ^{11}C, in order to clarify the mechanism for the formation of these products. Initial studies showed that iodine scavenger lowers the yields of all of these products except acetylene, while increased radiation dose increased the yields of products other than acetylene. Individual and relative yields of the two-carbon products are shown to be highly dependent on the structure of the target molecules. The results are discussed in terms of the decomposition modes available to the activated complexes assumed to result from insertion-type reactions of three primary species: ^{11}C, ^{11}CH, and $^{11}CH_2$. Reactions of recoil ^{11}C atoms with mixtures of benzene and methylcyclopentane were studied. The yields of these products are approximately linear functions of the molar concentrations of the two components. (auth)

8994 IMPROVEMENT OF ADHESIVE PROPERTIES OF PLASTICS BY RADIATION GRAFT POLYMERIZATION. **Manaka, Kazuo; Tomioka, Tamotsu (Tokyo Shibaura Electric Co.). J. Appl. Polymer Sci.,9: 3635-48 (Nov. 1965).**

Epoxy compounds such as allyl glycidyl ether, phenyl glycidyl ether, and Epicote 812, which are not polymerizable by irradiation, were irradiated by γ rays to a total dose of 1×10^7 to 2×10^8 r, and decomposition of epoxy radicals was examined. The epoxy radicals were found to be more or less radiation-resistant and for the greater part to remain unchanged. Methacryl glycidyl ester, which is polymerizable by irradiation, was radiation-grafted to polyethylene and to polytetrafluoroethylene by simultaneous irradiation with γ rays, and the degree of grafting was checked. Two sheets of radiation-graft polyethylene or polytetrafluoroethylene were bonded with epoxy resin adhesives containing polyamide hardener, and bond strength was examined. This showed that the bond strength of grafted polymer is larger than that of the nongrafted one. (auth)

8995 FILM LAMINATION BY RADIATION-INDUCED POLYMERIZATION OF ACRYLIC ACID. **Marans, N. S.; Addy, W. D. (Grace Research Div., Clarksville, Md.). J. Appl. Polymer Sci., 9: 3661-80(Nov. 1965).**

Monomeric acrylic acid, when placed between two polymeric films, may be polymerized almost explosively at a dose of 0.3 Mrad with electrons. The resultant exotherm led to bonding of the two films and the preparation of an interlaminar layer of polyacrylic acid. Changes in oxygen permeability were found for the resultant sandwich. The exotherm and the resultant bonding was dependent on the dose rate, dose, and the volume of acrylic acid used for the interlaminar layer. The results qualitatively followed the mechanism for explosive polymerization. (auth)

8996 EXAMINATION OF VARIABLES IN THE RADIATION-INDUCED SOLID-STATE POLYMERIZATION OF TRIOXANE. **Marans, Nelson S.; Wessells, Forrest A. (Washington Research Center, Clarksville, Md.). J. Appl. Polymer Sci., 9: 3681-3700(Nov. 1965).**

Radioinduced, solid-state polymerization of trioxane was studied. The out-of-source polymerization rate was investigated as a function of radiation dose and of temperature and time of polymerization. The empirical relation of log time $\propto$ Y (where Y is the polymerization percentage) was found to be satisfactory over wide ranges of conversion, dose, and polymerization time. At a given dose, the yield was directly proportional to the RSV (reduced specific viscosity). Either increasing the dose or decreasing the particle size gave lower RSV values at the same conversions. (auth)

8997 γ-RAY-INDUCED ISOMERIZATION OF cis- AND trans-1,2-DIPHENYLCYCLOPROPANE. **Brown, W. G. (Argonne National Lab., Ill.) J. Phys. Chem. 69: 4401-2(Dec. 1965).**

The pure liquid cis- and trans-1,2-diphenylcyclopropane exhibited geometrical isomerization and rearrangement to cis- and trans-1,3-diphenylpropene. The irradiation of pure liquid trans-1,3-diphenylpropane revealed isomerization to the cis isomer (G = 9.0 at 4% conversion and 5.4 at 12% conversion) but there was no detectable formation of cyctopropane derivatives. Yields from irradiation of cis- and trans-1,2-diphenylcyclopropane, at doses of 9 to 18×10^{19} ev/g, in benzene were also determined. On a prolonged exposure, 2×10^{21} ev/g, solutions of either isomer tended toward a trans:cis ratio of 1:15. (F.J.H.)

8998 ADSORPTION UNDER IRRADIATION. I. ADSORPTION OF OXYGEN AND CARBON MONOXIDE ON ALUMINA. **Coekelbergs, R.; Crucq, A.; Decot, J.; Degols, L.; Randoux, M.; Timmerman, L. (Institut Interuniversitaire des Sciences Nucleaires, Brussels). J. Phys. Chem. Solids, 26: 1983-93(Dec. 1965). (In French).**

The sorption phenomena is studied when alumina, in the presence of a gaseous phase (CO or O_2), is irradiated with x rays (55 kv). Qualitatively, these two gases give identical results. It was observed that irradiation always induces irreversible adsorption; and that after irradiation is stopped, adsorption continues (post radiation effect). Three periods—an induction period, a period during which the rate remains constant, and a period during which the rate of adsorption decreases slowly, until final attainment of an equilibrium state—can be distinguished on the curve of the adsorption evolution during irradiation. These results are qualitatively explained with the aid of a theoretical model which allows both for the charge carriers created in the course of the irradiation process and for the impurity levels susceptible to trap these carriers. (auth)

8999 DIFFUSION OF KRYPTON IN RUBIDIUM CHLORIDE AND ITS DEPENDENCE ON RADIATION DAMAGE. **Bannasch, W.; Schmeling, P. (Institut fuer Radiochemie, Gesellschaft fuer Kernforschung, Karlsruhe, Ger.). J. Phys. Chem. Solids, 26: 1999-2005(Dec. 1965).**

The diffusion of krypton in neutron irradiated rubidium chloride was determined by measuring the release of ^{85m}Kr. After negligible irradiation the gas release mechanism corresponded to ideal diffusion. Above 360°C the process was characterized by an activation energy of 10 ± 2 kcal/mole and diffusion by an interstitial mechanism seems probable. Irradiation to high neutron doses resulted in a marked decrease of the measured diffusion coefficient. The healing out of damaged lattice regions was demonstrated as a rapidly increasing krypton release during an isothermal anneal. Possible diffusion mechanisms in the damaged lattice are discussed. (auth)

9000 KINETICS OF RADIATION-INDUCED ALLYL POLYMERIZATION. [PART] I. Dolmatov, S. A.; Polak, L. S. (Topchiev Inst. of Petroleum-Chemical Synthesis, Academy of Sciences, USSR). Kinet. Kataliz., 6: 797-801 (Sept.-Oct. 1965). (In Russian).

The kinetics of the radioinduced polymerization of allyl alcohol as a solid and in azeotropic mixtures with water were investigated. It is shown that the speed of conversion is constant and does not depend on the polymer yield, is directly proportional to the dose, increases in aqueous solution in comparison with solid polymerization, and decreases with decreasing temperature. The activation energy of the polymerization depended on the temperature and increased in the interval from −78 to 300°C from ≈1 to ≈7 kcal/mole both in the case of polymerization of the solid and in azeotropic mixtures with water. The radiochemical yield of the polymer in the same temperature interval increased from ≈10 to 10^{-3} mole/100 ev. Dilatometric curves and the size of the radiochemical polymer yields indicated 7 allyl monomers. (tr-auth)

9001 RADIATION-INDUCED CHEMICAL DECOMPOSITION OF $KClO_4$. Dubovitskii, A. V.; Manelos, G. B. (Inst. of Chemical Physics, Academy of Sciences, USSR). Kinet. Kataliz., 6: 828-35(Sept.-Oct. 1965). (In Russian).

The nature, accumulation kinetics, and recombination of paramagnetic centers, produced in potassium perchlorate under the effects of ionizing radiation at 77 to 450°K, was studied by the EPR method. The recombination reactions of the radicals ClO_2 and O_3^- seemed to be of the second order. (tr-auth)

9002 RADIOLYSIS OF WATER VAPOR IN THE PRESENCE OF ZnO AND V_2O_5 SEMICONDUCTORS. Bubyreva, N. S.; Dolin, P. I.; Kononovich, A. A.; Rosenblum, N. D. Kinet. Kataliz, 6: 936-8(Sept.-Oct. 1965). (In Russian).

It was established that during radiolysis of pure water vapor the yield of molecular products can be significantly increased by means of electron semiconductors of zinc oxide. It was assumed that the semiconductor sensitization in the case of zinc oxide occurs by the capture of absorbed water molecules by excited electrons of the semiconductor and by the photodecay of water molecules because of thermal luminescence. (tr-auth)

9003 CHEMICAL EFFECTS OF $^{31}P(n,\gamma)^{32}P$ REACTION IN TRIPHENYLPHOSPHINE AND TRIPHENYLPHOSPHINE OXIDE. Berei, Klara. Magyar Tud. Akad. Kozp. Fiz. Kut. Int. Kozlemen., 13: 291-6(1965). (In Hungarian).

Triphenylphosphine oxide and triphenylphosphine, as well as a mixture of the two, were irradiated with 10^{13} n/cm^2 sec flux in a reactor. It was found that only a small fraction of ^{32}P activity (6% in the former, 25 to 28% in the two latter cases) remained in the original compound on irradiation. Identification of the mechanism of the chemical changes induced by the nuclear reaction was rendered difficult because they are to a large extent masked by simultaneously occurring radiation chemical processes. (auth)

9004 EVIDENCE OF THERMAL AND HOT PROCESSES IN THE "HOT-ZONE" PRODUCED BY ^{64}Cu RECOIL ATOMS IN SOLIDS. Yoshihara, Kenji; Ebihara, Hiroshi (Japan Atomic Energy Research Inst., Tokyo). Nature, 208: 482-3(Oct. 30, 1965).

Evidence of thermal and hot processes in the hot zone in solids was found in the study of hot-atom chemistry of copper-64 recoil atoms in α- and β-copper phthalocyanines. The relation between the initial retention and irradiation temperatures is shown. It is seen that the initial retention in β crystals at low temperature is much higher than in α crystals. There is also a difference in the initial annealing rates for the two crystals, which is also shown. An estimation of thermal and hot process in the hot zone together with the method of analysis is given. This kind of analysis is limited to the polymorphic crystals in which structure-sensitive reactions are concerned. Although this method is not very accurate, it makes possible an estimation of thermal and hot processes, between which it was previously difficult to discriminate in solids. (J.F.P.)

9005 RADIOLYSIS OF SODIUM TETRATHIONATE DIHYDRATE. Eager, R. L.; Mahadevappa, D. S. (Univ. Saskatchewan, Can.). Nature, 208: 781-2(Nov. 20, 1965).

The radiolysis of solid $Na_2S_4O_6 \cdot 2H_2O$ was studied. The compound was prepared by reacting iodine with sodium thiosulfate. Gamma radiation, at a dose rate on the order of 1,200 rads/min, was used to irradiate the samples. Electron spin resonance spectra were used to estimate the number of spins present in the irradiated samples. Electron spin concentrations were measured by graphical double integrations of the recorded spectra and comparison, through a substandard of γ-irradiated barium dichloroacetate, with solutions of diphenylpicrylhydrazyl in benzene. Tracer studies using ^{35}S were used to determine the source of the sulfur in the product H_2S. Results indicated that 25% of the H_2S sulfur came from the oxygen-bonded sulfur atoms of the $S_4O_6^{2-}$ ion and 75% from the two sulfur atoms in the center of the chain of four sulfur atoms. (F.J.H.)

9006 RADIOINDUCED PHASE TRANSFORMATIONS IN BARIUM TITANATE. Mietz, I. (Humboldt-Univ., Berlin). Naturwissenschaften, 52: 537(1965). (In German).

Polycrystalline tetragonal $BaTiO_3$ and, for comparison, monoclinic $CaTiO_3$, cubic $SrTiO_3$, and cubic stabilized $BaTiO_3$ were irradiated under various conditions in the Rossendorf Research Reactor. In the tetragonal $BaTiO_3$, after a dose of 4.2×10^{18} fast neutrons/cm^2, a radioinduced phase transformation in the cubic modification occurred. This phase was metastable at room temperature and was converted into the tetragonal modification after 20 hr of annealing above 1100°C. After a radiation dose of 6.2×10^{18} fast neutrons/cm^2, $CaTiO_3$, $SrTiO_3$, and cubic stabilized $BaTiO_3$ showed no transformation into other modifications. (J.S.R.)

9007 THE CHEMICAL EFFECTS ASSOCIATED WITH THE (n,2n) REACTIONS IN ORGANIC HALIDES. Shiokawa, Takanobu; Sato, Toshior; Izawa, Gunzo; Kondo, Kenjiro; Sato, Koji (Tohoku Univ., Sendai). Nippon Kagaku Zasshi, 86: 1006-9(Oct. 1965). (In Japanese).

The yields of radioactive organic products resulting from (n,2n) activation in ethyl bromide, bromobenzene, methyl iodide, ethyl iodide, and n-butyl iodide, were examined and compared with those from the (n,γ) reaction. The overall organic yields in bromides were apparently higher than those from the (n,γ) reaction, while iodides gave similar results in both nuclear reactions. The high-energy reaction yields were in agreement with those in the (n,γ) reaction. These results indicated that the recombinations in the high-energy region are independent on initial states of recoil atoms. The mechanism of the recombination could be explained successfully by the impact model proposed by Estrap-Wolfgang and extended by Milman to the liquid bromides. The effects of temperature and radiation expected on the organic yields in the thermal range were investigated. (auth)

9008 THEORETICAL ESTIMATION OF THE ENERGIES EVOLVED IN SOME REACTIONS OCCURRING IN THE GAMMA-IRRADIATED AQUEOUS SOLUTIONS. Pecul, Krzysztof (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). Nukleonika, 10: 361-70 (1965).

The energies released in some reactions involving oxygen hydrides arising in gamma-irradiated aqueous solutions were estimated. The energies of reactants and those of the products of the reactions, from which the estimates of the evolved energies resulted, were calculated by the united atom method. The result suggested that the isolated tetrahedral H_4O^+ is not a stable system. A way more accurately estimating the energy of autodissociation of H_4O^+ and the possibilities of further applications of the method are discussed. (auth)

9009 EPR SPECTRA OF GAMMA IRRADIATED SINGLE CRYSTALS OF SODIUM SUCCINATE. Minc, Stefan; Kecki, Zbigniew; Kosek, Stanislaw (Inst. of Nu-

clear Research, Polish Academy of Sciences, Warsaw). Nukleonika, 10: 371-4(1965).

The changes in the EPR spectra of gamma-irradiated crystals of sodium succinate with rotation about chosen axes were studied and the hyperfine structure was interpreted. The radical $NaO_2CCH_2\dot{C}H_2$ was stable at room temperature and the radical $\cdot CO_2(Na)$ was not stable. This fact confirmed the supposition that the single line observed in β-succinic acid proceeds from the radical $HO_2CCH_2CH_2COO\cdot$. (auth)

9010 HOMOPOLYMERIZATION OF SOME ALKYL MALEATES AND DIETHYL FUMARATE UNDER INFLUENCE OF GAMMA IRRADIATION. II. INFRA-RED STUDY ON THE STRUCTURAL TRANSFORMATIONS IN GAMMA IRRADIATED DIETHYL MALEATE AND DIETHYL FUMARATE. Czarnodola, Helena; Stachowicz, Waclaw (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). Nukleonika, 10: 375-80(1965).

Infrared spectra of separated radiopolymerization products of diethyl maleate and diethyl fumarate were compared with those of monomers. On the basis of the analysis of C=O, C—O, C=C, =C—H absorption on bands, the disappearance of carbon–carbon double bond in polyesters was found. The structure of both polyesters is suggested. (auth)

9011 ELECTRON SPIN RESONANCE OF FREE RADICALS IN PERHYDROTRIPHENYLENE INCLUSION COMPOUNDS. Griffith, O. Hayes. (Stanford Univ., Calif.). Proc. Nat. Acad. Sci. U. S., 54: 1296-9(Nov. 1965).

The results of electron spin resonance (ESR) investigations at room temperature of x-ray-produced free radicals in ester PHTP (perhydrotiphenylene) inclusion compounds are reported. Single crystals of the ester-PHTP inclusion compounds were grown by slowly lowering the temperature of a solution of PHTP dissolved in the ester. The spectrum of an ethyl heptanoate-PHTP crystal with the magnetic field in the xy plane is given. The spectrum remained unchanged as the crystal was rotated about the crystalline z plane. This was also the case for the ethyl octanoate, ethyl nonanoate, and octyl propionate inclusion compounds. Coupling constant data are given. (F.J.H.)

9012 COPPER-INDUCED RADIOLYTIC DEACTIVATION OF α-AMYLASE AND CATALASE. Anbar, M.; Levitzki, A. (Stanford Univ., Calif. Soreq Research Establishment, Rehovoth, Israel). Radiat. Res., 27: 32-40(Jan. 1966).

The radiolytic deactivation of α-amylase and catalase in dilute neutral aqueous solutions was inferred to be due primarily to the action of OH radicals. The deactivation of α-amylase was doubled in the presence of about three-fold excess of Cu^{2+} mole/mole. A thirtyfold excess of Cu^{2+} over catalase gave a similar effect. It is suggested that copper bound to the enzyme may induce its deactivation by the action of oxidizing free radicals. The possible role of copper in radiobiological damage is discussed. (auth)

9013 SOLID-STATE POLYMERIZATION INDUCED BY RADIATION. Charlesby, A. (Royal Military Coll. of Science, Shrivenham, Eng.). Rep. Progr. Phys., 28: 463-518(1965).

While the radiation-induced polymerization of monomers in the liquid or gas phase or in solution has been thoroughly investigated over a period of years, polymerization in the solid state under the influence of high-energy radiation has only recently attracted attention. The reactions involved appear to be quite different from those in the corresponding liquid monomers, being largely dominated by the crystalline environment and orientation of the monomer units. No single pattern of behavior emerges from the very numerous monomeric systems studied. In one group the polymerization rate is considerably enhanced by monomer orientation within the crystal lattice, and oriented polymer may be formed directly in suitable crystals. In another group of monomers crystallinity impedes the reaction, which then tends to be initiated at crystalline defects to give amorphous polymer within the original crystalline lattice. Very different reaction rates may be observed in the same monomer, depending on its crystalline or amorphous (glass-like) environment. Other experiments emphasize the influence of crystallite size and perfection, of internal and external stresses, and of non-reactive groups incorporated within the solid. In suitable crystals, the orientation of each monomer unit, at the precise moment of its addition to the growing chain, may be deduced from the physical properties of the resultant polymer. In many monomers the reaction continues after the cessation of radiation; in others the initiating centers formed by radiation only become effective subsequently when the temperature is raised. Several explanations of these post-radiation effects were suggested. Solid-state polymerization induced by radiation promises to become a valuable method for investigating the mobility of organic molecules within crystalline and amorphous solids, the nature and distribution of defects and dislocations, and the influence of temperature and pressure on their behavior. (auth)

9014 RADIATION INDUCED GRAFT POLYMERIZATION OF STYRENE TO POLYETHYLENE SINGLE CRYSTAL AGGREGATES. Shinohara, Kenichi; Takamatsu, Toshiaki, Kaibara, Makoto; Fukada, Eiichi. Rika Gaku Kenkyusho Hokoku, 41: 204-7(1965). (In Japanese).

9015 IRRADIATION OF BIOLOGICAL TISSUES AND OTHER SAMPLES WITH NEUTRONS. I. ACTIVATION OF BIOLOGICAL TISSUES IN THE REACTOR. Rakovic, Miloslav (Charles Univ., Prague). Sb. Lekar., 64: 216-19(1962). (In Czech).

Neutron activation analysis and the preparation of samples for activation are considered. Samples were irradiated 48 hours with a neutron flux of 1.5×10^{12} neutrons/cm^2 sec. Biological samples and standards were sealed in polyethylene tubes 40 mm in length and 5 mm in dia; other samples were irradiated on filter paper, but showed activity diminished by two orders of magnitude. Detection was made using a Geiger-Müller counter for the detection of β rays. A discussion of the decomposition of fission curves follows. A set of curves is presented for some impure samples in which an isotope with a half life of about 15 hours predominates. It is suggested that this isotope may be ^{24}Na, whose half life is known to be 14.8 hours, and which is produced by a n,γ reaction with a cross section of 0.51 barn. The remainder of the sample may be studied after about 90 to 100 hours, when the contribution of this isotope is nearly negligible. (BBB)

9016 IRRADIATION OF BIOLOGICAL TISSUES AND OTHER SAMPLES WITH NEUTRONS. II. THE USE OF A POLONIUM–BERYLLIUM SOURCE FOR ACTIVATION OF LIQUID SAMPLES. Rakovic, Miloslav (Charles Univ., Prague). Sb. Lekar., 64: 220-4(1962). (In Czech).

The properties of the Po-Be source are described; it is compared with other neutron sources and its advantages and disadvantages are evaluated. A practical arrangement for a Po-Be source is illustrated for the insertion of liquid samples in a source with a dose of 11.3×10^6 neutrons/cm^2 sec. The dependence of the activity of various samples on the thickness of the paraffin block placed between the sample to be irradiated and the Po-Be block is illustrated. For activation of a larger (15 ml) sample of a 10% solution of I or V (to produce respectively ^{128}I or ^{52}V by n,γ reactions) for standard periods of time ranging from 30 min to 3 hours, no loss in activity is noted until more than 1 cm of paraffin is interposed between the source and the sample. For a 5 ml sample of either element (10%) a max is apparently reached with 1 cm of paraffin between sample and source. This maximum is about 1370 imp/min for I_2 in ethyl alcohol and 760 imp/min for the V solution. The 15 ml samples showed somewhat more than three times these activities. The installation allows easy, rapid and safe manipulation and conditions are easily adaptable to maximum efficiency. (BBB)

9017 DESIGN OF THE ARGONNE ISOTOPIC SOURCE NEUTRON FACILITY. Mohr, W. C.; Wahlgren, M. A.; Stewart, D. C. (Argonne National Lab., Ill.). pp 138-41 of Proceedings of the 13th Conference on Remote Systems Technology, 1965. Hinsdale, Ill., American Nuclear Society, 1965.

Small high intensity isotopic neutron sources have some experimental advantages over reactors. They are easily portable, flexible in use, not subject to shutdown, and produce a flux that is invariant in quality and whose relatively slight change in strength can be accurately predicted. A facility utilizing 12 curium-americium-beryllium sources with a total output (in May, 1965) of 7.5×10^9 neutrons per second was installed in one of the high-level cells of the Argonne Chemistry Hot Laboratory. The primary purpose of this facility is to develop and refine experimental techniques and equipment, to be prepared to exploit the virtues of potent compact neutron sources when adequate (milligram) quantities of spontaneously fissioning ^{252}Cf may be available for this use. (auth)

9018 160,000 CURIE ^{60}Co FACILITY. Harvey, H. W.; Hoh, J. C.; Podolski, W. F.; Youngquist, C. H. (Argonne National Lab., Ill.). pp 152-6 of Proceedings of the 13th Conference on Remote Systems Technology, 1965. Hinsdale, Ill., American Nuclear Society, 1965.

An Argonne Chemistry Division Hot Cell was redesigned to accommodate a 160,000-curie ^{60}Co source. The revisions of the existing cell and the design of new storage and handling equipment are described. Calculations dealing with shielding and heat transfer problems are also included. (auth)

9019 CHEMICAL EFFECTS OF NUCLEAR TRANSFORMATIONS. Maddock, A. G. (Cambridge Univ., Eng.). pp 7-16 of Primera Conferencia Interamericana de Radioquimica. Washington, D. C., Union Panamericana, 1965.

The theoretical and technical information that can be gained in a study of the chemical effects of nuclear transformations are illustrated with two examples. One is the reaction of tritium produced by $^3He(n,p)T$ reactions with hydrocarbons. Studies were also made of radiation damage in solids, particularly annealing processes. (J.S.R.)

9020 RADIOLYSIS OF ALIPHATIC DICHLORIDES. Wiley, R. H.; Patterson, R. L. S.; Bierbaum, B.; Parish, D. J.; Gruenhut, E. (Univ. of Louisville, Ky.). pp 183-7 of Primera Conferencia Interamericana de Radioquimica. Washington, D. C., Union Panamericana, 1965.

The formation of hydrogen chloride and other products during γ irradiation of propyl and butyl dichlorides was studied and the effects of some additives were determined. The radiolysis of initially pure dichlorides showed that the net rate of production of HCl with increasing doses remained constant or slightly decreased and the presence of competing reaction steps with the consumption of HCl is suggested by the data. The effect of water, HCl, and O_2 on the production of HCl was determined. The addition of HCl decreased the yield. The probable reaction mechanism is discussed. (J.S.R.)

9021 STUDIES OF ANNEALING OF ANTIMONY COMPOUNDS IRRADIATED WITH NEUTRONS. Facetti, J. F.; Trabal, E.; Torres, S. (Comision de Energia Atomica del Paraguay, Asuncion). pp 233-6 of Primera Conferencia Interamericana de Radioquimica. Washington, D. C., Union Panamericana, 1965. (In Spanish).

The annealing process in Sb_2O_3 and $KSb(OH)_6$ irradiated with neutrons for 4 minutes at a flux of 2×10^{12} neutrons/cm^{-2}/sec^{-1} was studied. The final annealing was done after irradiation using either boiling water or a thermostatically controlled furnace. The Sb_2O_3 samples were annealed at 130, 200, and 250°C. The $KSb(OH)_6$ samples were annealed at 200, 300, and 100°C. The annealing curves for both compounds are given. The shape of the annealing curves suggested the formation of intermediate valent states of antimony that are captured in the lattice immediately after formation and only after annealing can they reach their final states. (J.S.R.)

9022 RECOIL MECHANISM IN SOME COBALT COMPLEXES. Maddock, A. G. (Cambridge Univ., Eng.); Todesco, A. B. J. B. pp 237-40 of Primera Conferencia Interamericana de Radioquimica. Washington, D. C., Union Panamericana, 1965.

The recoil reactions in trans-trinitrotriamminecobalt, trans-dinitrotetraamminecobalt, trans-tetranitrodiamminecobaltate, cis-dinitrotetraamminecobalt, trans-tetranitrodiamminecobaltate, trans-dinitrotetraamminecobalt nitrite, and ammonium trans-tetranitrodiamminecobaltate were investigated. The recoil products were separated and identified by means of electromigration on paper and 8 products were found. The results of measurement of the distribution of the major Co(III) recoil products expressed as a percentage of the total Co(III) present were tabulated. A model was developed using the concept of the cavity complex, which is the complex molecule in the crystal lattice without the Co atom. The model is used to explain the mechanism of the ligand substitution in the targets. (J.S.R.)

9023 APPLICATION OF OPTICAL TECHNIQUES TO STUDIES OF RADIATION EFFECTS. Compton, D. M. J.; Bryant, J. F.; Cesena, R. A.; Gehman, B. L. (General Atomic Div., General Dynamics Corp., San Diego, Calif.). 24p. (CONF-650707-19; GA-6565). ORINS.

From IEEE Annual Conference on Nuclear and Space Radiation Effects, Ann Arbor, Mich.

The value of optical measurements (emissions, absorption, photoconductivity) in the study of radiation effects is discussed. Examples are given for radioinduced conductivity in KCl, kinetics of radiation damage in silicon, radioinduced conductivity in liquids, e.g., liquid NH_3, and recombination processes in ruby and Mylar. (auth)

9024 METHOD FOR PRODUCING FORMALDEHYDE POLYMER. Tsuda, Teizo (to Toyo Rayon Co., Ltd.). Japanese Patent 1964-14828. July 27, 1964. Filed Jan. 12, 1960.

Different radiation-induced polymerizations of formaldehyde were studied, and it was found that the polymerization proceeded most satisfactorily when the formaldehyde dissolved in an inert solvent was irradiated at low temperature (-21 to -80°C). The polyoxymethylene produced had good heat stability as well as a high degree of polymerization. (NSA of Japan)

9025 METHOD FOR PRODUCING FOAM POLYOLEFIN RESIN. Aine, Norio (to Sekisui Chemical Co., Ltd.). Japanese Patent 1964-24131. Oct. 28, 1964. Filed Apr. 4, 1962.

The method described consists of irradiating the resin in an oxygen-containing atmosphere by ionizing radiation, followed by heating at above 120°C under a reduced pressure (below 200 mm Hg). A foam polyolefin resin of high porosity is obtained. (A.G.W.)

9026 METHOD FOR PRODUCTION OF POLYMERS OF α,α-BIS(CHLOROMETHYL)-β-PROPIOLACTONE. Fukui, Kenichi (to Sumitomo Chemical Co., Ltd.). Japanese Patent 1964-24288. Oct. 29, 1964. Filed Dec. 14, 1961.

The proposed method employs irradiation by ionizing radiation of the α,α-bis(chloromethyl)-β-propiolactone. It was found, as a result of the studies of the polymerization of β-lactones, that by the irradiation, a high polymer of α,α-bis(chloromethyl)-β-propiolactone whose softening point was variable between 200 to 300°C or above was obtainable. α,α-bis(chloromethyl)-β-propiolactone may be irradiated in the presence or absence of a solvent. (NSA of Japan)

Radiochemistry

See also Separation Processes and Procedures

Refer also to abstracts 8980 and 9196.

9027 (AERE-R-4886) STANDARDISATION OF $^{47}Ca/^{47}Sc$. Hiscott, J. E. (Research Group, United

Kingdom Atomic Energy Authority, Wantage (England)). Nov. 1965. 17p. Dep. BIS $0.60. HMSO 3s.

A method of standardizing $^{47}Ca/^{47}Sc$, with the estimation of low concentrations of ^{45}Ca in the $^{47}Ca/^{47}Sc$ solution is outlined. Equations relating count rates at any time after a reference time, and the activities of the three isotopes at the reference time were established and the analysis of sets of equations to find the optimum solution is described. Investigations on the accuracy of measurement of the ^{47}Ca content, and the reliability of detection of low level ^{45}Ca content are described, and the minimum duration of counting required to obtain a reproducible solution is discussed. It is estimated that from five days counting the accuracy of the ^{47}Ca and ^{47}Sc activities is better than 2%, and an upper limit of the ^{45}Ca concentration can be stated. (auth)

9028 (CNEA-157) PREPARACION DE ACIDO DL-TARTIARICO-1,4-^{14}C. (Preparation of DL-Tartaric Acid-1,4-^{14}C). Buehler, Mauricio F.; Mitta, Aldo E. A.; Lopez, Rodolfo (Comision Nazional de Energia Atomica, Buenos Aires (Argentina)). 1965. 5p. (CONF-620910-1). Dep. mn.

From 8th Latin-American Congress on Chemistry, Buenos Aires.

The preparation of DL-tartaric acid-1,4-^{14}C via formation of glyoxal cyanohydrin and its hydrolysis to tartaric acid by refluxing with hydrochloric acid is described. The racemic tartaric acid was isolated in form of calcium tartrate, which was dissolved in hydrochloric acid, reprecipitated, liberated by means of Dowex-50 resin, and crystallized. The purity of the product was established through its melting point, paper chromatography, and autoradiography. Starting with 4 mC of active potassium cyanide, DL-tartaric acid-1,4-^{14}C with a specific activity of 0.2 mC/mmole was obtained in a yield of 34%. (auth)

9029 THE IRRADIATED MATERIALS WORKSHOP (A.M.I.) AT THE CHINON POWER PLANT. Garaud, M. J. Bull. Inform. A.T.E.N. (Ass. Tech. Energ. Nucl.), No. 55, 37-49(Sept.-Oct. 1965). (In French).

The irradiated materials workshop consists essentially of installations for control of irradiated materials and of installations for the treatment of waste and for decontamination. Each of these is described. (J.S.R.)

9030 REACTOR PRODUCTION OF CARRIER-FREE ^{54}Mn FROM NATURAL IRON. O'Brien, H. A. Jr. (Oak Ridge National Lab., Tenn.). Int. J. Appl. Radiat. Isotop., 16: 747-9(Dec. 1965). (ORNL-P-1164).

Mn-54 production rates from natural iron in a number of core positions in the ORR and LITR were measured. Millicurie quantities of carrier-free ^{54}Mn were prepared. The most abundant source of fast neutrons in the ORR was in a partial fuel element. In such a facility, an extrapolated maximum production of 15 mC of ^{54}Mn per gram of natural iron was obtained for a 22-day irradiation. Lower yields in the LITR were partially due to the fact that its maximum operating power level is a factor of 10 less than that of the ORR. (M.C.G.)

9031 CHEMISTRY AT HIGH VELOCITIES. Wolfgang, Richard. Sci. Amer., 214: 82-90(Jan. 1966).

The study of "hot chemistry," high-energy chemical reactions is reviewed. Reactions of tritium atoms with a kinetic energy of 10 or less are described. The reactions of recoil tritium with methane and propane were studied. Uses of scavengers and moderators to study hot reactions are described. It is shown that hot reactions are more efficient than reactions of minimal energy. It was found that in most cases a tritium atom apparently breaks only one bond when it combines with molecules such as propane. The various types of hot reactions are discussed. It was concluded that a hot collision can be so fast that the inertia of the heavier atoms in the molecule struck is too great for them to move rapidly enough to make some reactions possible. The replacement of fluorine by hot tritium in methyl fluoride is considered. Reactions of ^{18}F and ^{14}C are also being studied. (M.C.G.)

9032 PRIMERA CONFERENCIA INTERAMERICANA DE RADIOQUIMICA, MONTEVIDEO, URUGUAY, 23 AL 26 DE JULIO DE 1963. (First Inter-American Conference on Radiochemistry, Montevideo, Uruguay, July 23-26, 1963). Washington, D. C., Union Panamericana, 1965. 372p. $3.00. (CONF-115).

Fifty-six papers and the comments and discussions following the papers presented at the First Inter-American Conference of Radiochemistry are compiled. Individual abstracts were prepared for 38 of the papers. Eleven papers were previously abstracted for NSA and appeared as abstracts 17: 6126, 20059, 21871, 26784, 35867, 38920, 41867; 18: 267, 16149, 32029, 33664, and 33665. (J.S.R.)

For abstracts of individual papers see: 8538, 8587, 8863–8871, 8956, 8957, 8973–8977, 9019–9022, 9033–9038, 9083–9087, 9157, 9211, and 10107–10109.

9033 STATE OF AN ELEMENT OBTAINED BY BETA DECAY OF THE MOTHER NUCLIDE CONTAINED IN THE MOLECULE OF THE EDTA COMPLEX. Cendales, M.; Arroyo, A.; Nassiff, S. J. (Institut de Asuntos Nucleares, Bogota). pp 179-81 of Primera Conferencia Interamericana de Radioquimica. Washington, D. C., Union Panamericana, 1965. (In Spanish).

The conditions of the isotopic exchange between the EDTA complex of Ce(III) and the effect of β decay of ^{144}Ce to ^{144}Pr were studied. The kinetics of the exchange at pH 7.2 and 0°C were determined and the results are tabulated. It was determined that approximately 70% of the ^{144}Pr formed leaves the molecule because of recoil effects. The binding energy of the molecule of the complex was less than 35.6 kcal/mole, the recoil energy. (J.S.R.)

9034 PREPARATION OF RADIO-LEAD AND RADIO-BISMUTH FOR USE AS TRACERS AND SOURCE-SAMPLES. Abrao, Alcidio (Instituto de Energia Atomica, Sao Paulo, Brazil). pp 281-8 of Primera Conferencia Interamericana de Radioquimica. Washington, D. C.; Union Panamericana, 1965. (In Portuguese).

A method for the preparation of ^{212}Pb, ^{212}Bi, and ^{212}Po from solutions of thorium nitrate is proposed. The method consists of the addition of bismutiol (2,5-dimercapto-1,3,4-thiodiazole) to the nitrate solution with the subsequent filtration or centrifugation. The advantages of recrystallization of the bismutiol or the precipitation of mercury or copper for the collection of the radioisotopes are compared. The purity of the products obtained is adequate. The techniques used for the plating of the radioisotopes on copper, gold, or silver foils is described. (J.S.R.)

9035 DEVELOPMENT AND PERSPECTIVES OF RADIOCHEMISTRY IN ARGENTINA. Flegenheimer, J.; Radicella, R. (Comision Nacional de Energia Atomica, Buenos Aires). pp 329-31 of Primera Conferencia Interamericana de Radioquimica. Washington, D. C., Union Panamericana, 1965. (In Spanish).

The development of radiochemistry in Argentina since its conception and its probable future development in the country are discussed. (J.S.R.)

9036 RADIOCHEMICAL RESEARCH AT THE INSTITUTO DE PESQUISAS RADIOATIVAS, UNIVERSIDADE DE MINAS GERAIS. Vargas, J. I. (Univ. de Minas Gerais, Belo Horizonte, Minas Gerais, Brazil). pp 333-41 of Primera Conferencia Interamericana de Radioquimica. Washington, D. C., Union Panamericana, 1965.

The staff, organization, and facilities available at the Instituto De Pesquisas Radioactivas are outlined. The research program may be classified under the following subjects: recoil studies, radiation dosimetry, isotope production, and tracer applications. Each of these is discussed. (J.S.R.)

9037 LABORATORY OF RADIOISOTOPES. Nussis, N. (Facultad de Ingenieria Guimica, Santa Fe, Argentina). pp 343-6 of Primera Conferencia Interamericana de Radioquimica. Washington, D. C., Union Panamericana, 1965. (In Spanish).

The radioisotope laboratory and its facilities are briefly described. The principal studies undertaken at the laboratory are tabulated. (J.S.R.)

9038 RADIOACTIVE MEASUREMENTS IN RADIOCHEMISTRY. Maddock, A. G. (Cambridge Univ., Eng.). pp 359-62 of Primera Conferencia Interamericana de Radioquimica. Washington, D. C., Union Panamericana, 1965.

The advantages, disadvantages, and the precautions necessary in radioactive measurements are reviewed. Scintillation counters, proportional counters, and solid-state detectors are considered. (J.S.R.)

9039 CENTRAL LABORATORY FOR HOT CHEMISTRY AT JULICH. Davis, J. M.; Javary, B.; Schloesser, L.; Tarbe de St. Hardouin, A. pp 69-74 of Proceedings of the 13th Conference on Remote Systems Technology, 1965. Hinsdale, Ill., American Nuclear Society, 1965.

A hot laboratory for chemistry is under construction at the Kernforschungsanlage–Jülich in Germany. Designed for work at activity levels varying from 0 to 2000 curies, the facility features two large barytes concrete cells and six laboratories in which lead-brick walls can be varied in thickness for shielding. Both the cells and the labs use interchangeable boxes for containment, and in the cells the boxes can be moved in and out entirely by remote control. The cells and labs share a common service area in accordance with the "hot corridor" system. (auth)

9040 RADIOACTIVE SOURCE CONFIGURATION FOR PRODUCING A UNIFORM FIELD. Attix, Frank H. Canadian Patent 719,009. Sept. 28, 1965.

The configuration is in the form of a hollow cylinder consisting of tubes each of which contains two radiation sources separated within the tube by $\sqrt{2}$ R, where R is the radius of the cylinder. Objects placed anywhere on cylindrical surface midway between the two rings of sources will receive uniform radiation. (F.S.A.)

9041 RADIOACTIVE REFERENCE SOURCE AND METHOD FOR MAKING THE SAME. Christianson, Charles; Maggio, Ralph C. (to U. S. Navy). U. S. Patent 3,217,165. Nov. 9, 1965. Filed June 12, 1961.

A method of preparing a beta radioactivity reference source consists of horizontally supporting a thin flat absorbent pad, saturating the pad with a known quantity of a predetermined percent solution of a material of known beta activity by evenly distributing the droplets of the solution on the upper surface of the pad, and air drying the pad. The specific activity of a radioactive salt can be determined by saturating two pads of identical geometry with identical quantities of identical percent solutions of a given salt, drying the pads, and counting the radioactivity emanating from the pads in the same geometry in the same measuring device. (B.L.M.)

9042 RADIOACTIVE PHOSPHORUS PROCESS. Gleason, Geoffrey Irving (to Abbott Labs.). U. S. Patent 3,218,132. Nov. 16, 1965. Filed May 24, 1963.

A process is described for dispersing neutron-irradiated sulfur in a water-miscible solvent and separating the purified ^{32}P by ion-exchange means. A dialkyl amine is a suitable water miscible solvent for the irradiated sulfur and associated ^{32}P, and cooling the solution precipitates a major portion of the sulfur while the ^{32}P remains in solution. After adsorption of the phosphorus values on a suitable anion exchange resin, the sulfur-free purified ^{32}P is eluted from the resin by a non-oxidizing acid. (B.L.M.)

Separation Processes and Procedures

See also Analytical Procedures
ISOTOPE TECHNOLOGY — Separation and Production

Refer also to abstract 9093.

9043 (IDO-14658) ICPP PROCESSING OF VBWR STAINLESS STEEL FUEL (APRIL 14 TO JUNE 2, 1965). Legan, R. W.; Kormanik, N.; Wheeler, B. R. (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). Dec. 1965. Contract AT(10-1)-205. 34p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

A method for processing high-enriched stainless steel-uranium alloy fuel elements from the Vallecitos Boiling Water Reactor is reported. Some of the capabilities of the plant and the process chemistry are discussed. (auth)

9044 (ORNL-3830, pp 30-68) POWER REACTOR FUEL PROCESSING. (Oak Ridge National Lab., Tenn.).

Research directed toward development of new methods for recovering and decontaminating U, Th, and Pu from spent fuels is reported. Efforts were devoted to development of methods for producing suitable aqueous feeds for solvent extraction and nonaqueous volatility processes. Work is reported on hydrolysis of uranium and thorium carbides, processes for graphite fuels, processes for UO_2-PuO_2 fuels, processes for Th–U fuels, chloride volatility of U and Pu, mechanical process development, close-coupled process development, and plant concepts. (J.R.D.)

9045 (ORNL-3830, pp 69-96) FLUORIDE VOLATILITY PROCESSING. (Oak Ridge National Lab., Tenn.).

Laboratory studies concerned with the use of $HF-O_2$ for removing stainless steel cladding from UO_2 fuel elements are described. Retention of Pu by alumina was also studied. Information is included on molten-salt processing of Al–U fuels, volatilization of PuF_6 from molten salts containing U, recovery of Pu and U from molten salts by fluorination, volatility processes for stainless steels and Zircaloy cladding and UO_2, fluidized bed pilot plant design, metal fluoride sorption of PuF_6, NaF sorption of UF_6, volatility process in-line gas monitoring, equilibria in UF_6-NbF_5 systems, phase equilibria in Cr-containing systems, UF_6 volatilization from fluorinated ThO_2-UO_2, and corrosion of hydrofluorinator and fluorinator materials of construction. (J.R.D.)

9046 (ORNL-3830, pp 140-56) TRANSURANIUM ELEMENT PROCESSING. (Oak Ridge National Lab., Tenn.).

Efforts devoted to development of flowsheets and equipment for processing transuranium elements are summarized. Information is included on development of chemical processes, design and fabrication of equipment, and construction of transuranium processing plant. (J.R.D.)

9047 (ORNL-3830, pp 157-73) CURIUM PROCESSING. (Oak Ridge National Lab., Tenn.).

Activities in a program to produce Cm heat sources for use in thermoelectric converters are reported. Information is included concerning development of processes for use in existing Cm processing facilities and in operation of a Cm recovery facility now under construction. (J.R.D.)

9048 (ORNL-3830, pp 174-92) DEVELOPMENT OF THE THORIUM FUEL CYCLE. (Oak Ridge National Lab., Tenn.).

Work toward development of fuel cycle technology required for economical power production in Th-fueled reactors is described. Information is included on design and construction of ^{233}U storage facilities, sol-gel process development, microsphere production, design and construction of Th–U recycle facilities, and equipment development for Th–U recycle facilities. (J.R.D.)

9049 (ORNL-3830, pp 193-221) SEPARATIONS CHEMISTRY RESEARCH. (Oak Ridge National Lab., Tenn.).

Results of research on reactions of materials to be separated, new separations reagents, and control of separations variables are reported. Development work on specific complete processes in these areas is in progress. Fundamental studies of separations equilibria

mechanisms are also in progress. Information is included on reagents for separation of Po from Bi, new extraction reagents, biochemical separations, performance of degraded reagents and diluents, extraction of actinides and lanthanides, recovery of Th, Be, and Rb from ores, recovery of acids by amine extraction, separation of biological macromolecules, separations of alkaline earths, bonding in organic mixtures, extraction of Sr, Cs, and Fe, and measurements of activity coefficients of solvent phases. (J.R.D.)

9050 (ORNL–3830, pp 222-7) RECOVERY OF FISSION PRODUCTS BY SOLVENT EXTRACTION. (Oak Ridge National Lab., Tenn.).

Activities in a program to develop processes for large-scale recovery of fission products from reactor-fuel processing wastes are described. Information is included on Cs recovery, Ce and Pm separations, Ru extraction, and mixer-settler efficiencies. (J.R.D.)

9051 (ORNL–3830, pp 228-32) CHEMISTRY OF PROTACTINIUM. (Oak Ridge National Lab., Tenn.).

Solvent extraction studies of Pa in H_2SO_4 solutions were continued. Evidence was obtained that in 2.5 $\underline{M}$ H_2SO_4 relatively-extractable polymeric species occur for Pa concentrations between a few thousandths and a few hundredths of a mg per ml, but at higher concentrations less extractable species appear. These less extractable species are probably larger polymers in slow equilibrium with the extractable species. Spectrophotometric studies in H_2SO_4 and HCl solutions are being started, and preliminary data for concentrated H_2SO_4 solutions of Pa from three different sources each gave a different spectrum. Recovery of the ^{231}Pa borrowed from England for use in preparing ^{232}U was completed, and all the material has now been returned. The equipment used for processing the ^{232}U some three years ago was exhumed from the burial ground, and 1.65 g of Pa was recovered from the dissolver vessel. (auth)

9052 (ORNL–3830, pp 248-51) MECHANISMS OF SEPARATIONS PROCESSES. (Oak Ridge National Lab., Tenn.).

The thermodynamics of solvent extraction by tributyl phosphate (TBP)–hydrocarbon-diluent solutions are being studied by means of vapor pressure measurements and analytical partition data. The multicomponent systems under study include the three-component system containing uranyl nitrate, nitric acid, and water, and the three- and four-component systems containing TBP, hydrocarbon diluent, water, and uranyl nitrate or nitric acid. (auth)

9053 (ORNL–3830, pp 252-60) CHEMICAL ENGINEERING RESEARCH. (Oak Ridge National Lab., Tenn.).

The work reported this year includes: the operation of the stacked-clone contactor with a variety of solvent systems (including 100% TBP and hexone) to show a wide range of applicability; further experimental work with the effect of radiation on the coalescence of liquid droplets, which clarifies the significance of the most important variables and provides a basis for an explanation; the adoption of a laser light source for the detection of aerosol particles in a gas stream by light scattering and a technique for manipulating the pulse from the light detector to give a more meaningful signal; and a comprehensive treatment of all the available data on flooding of solvent extraction pulsed columns to test over 200 proposed correlating equations. (auth)

9054 (ORNL–3830, pp 261-70) REACTOR EVALUATION STUDIES. (Oak Ridge National Lab., Tenn.).

Work during the past year included calculation of the costs of fuel shipping and processing and of preparing sol-gel oxide in connection with advanced converter evaluations related to ^{233}U value studies, and other reactor evaluation programs. Also included were the developments of computer codes for calculating shipping and processing costs and overall cost of nuclear power, and for calculating individual and gross concentrations and radioactivities of Th, U, transuranium elements, and fission products produced during reactor operation at constant flux or constant power. A manual of the design of casks for shipping spent fuel was published. Criticality problems and neutron-gamma shielding problems in fuel-cycle plants were also studied. (auth)

9055 (ORNL–3830, pp 299-305) MOLTEN-SALT REACTOR PROCESSING. (Oak Ridge National Lab., Tenn.).

Research programs concerned with processing molten salt fuels and blanket materials for recovery of ^{233}U are summarized. Information is included on continuous fluorination of molten salts, distillation of molten salts, fuel reconstitution for molten-salt breeder reactors, chromium fluoride trapping, and alternate processing methods for molten-salts. (J.R.D.)

9056 (SGAE-CH–22/1965) UNTERSUCHUNGEN ZUR WIEDERAUFBEREITUNG DER GRAPHIT-KARBID-BRENNSTOFFEINSAETZE VON HOCHTEMPERATURREAKTOREN. (Study on the Reprocessing of Graphite-Carbide Fuel Elements of High Temperature Reactors). Bildstein, H.; Knotik, K.; Stolba, G.; Wagner, H. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H.; Seibersdorf). [1964]. 26p. Dep.

Various process steps suitable for the reprocessing of fuel elements of high-temperature reactors are reported. A study was made to develop a new method with the steps of thermoshock, bromination, and chlorination. A review of the head-end methods for processing spent fuel elements showed that the newly developed method is applicable to all fuel element types presently used. (tr-auth)

9057 (ANL-Trans–227) THE REPROCESSING OF NUCLEAR REACTOR FUEL BY AQUEOUS-FLUORIDE VOLATILITY METHODS. Anderson, Cleve Richard. Translated by M. J. Steindler (Argonne National Lab., Ill.), from German Patent No. 1,184,745. Jan. 7, 1965. 16p. Dep. mn; JCL $1.60 fs, $0.80 mf.

An improved method is described for the chemical processing of highly radioactive power reactor fuel. The method makes possible a high degree of purification with a substantially reduced number of processing steps and a substantial reduction in the quantity of radioactive wastes when compared to well known methods. The method along with examples using uranium dioxide and thorium dioxide fuels are described. (P.C.H.)

9058 FILTER PURITY IN FLUIDIZED BEDS. PART I. ESTABLISHMENT OF THE OPTIMUM CONDITIONS. Otero, Alberto Rodrigo; Rof, Juan Sancho (Junta de Energia Nuclear, Madrid). Energia Nucl. (Madrid), 9: 279-87(July-Aug. 1965). (In Spanish).

The optimum conditions for the operation of a purification system for filters by blowing in the opposite direction were established. The air current from the blower necessary to provide a good purity was determined. The theory that imperfectly cleaned filters cause progressive increases in reactor pressure is discussed. The reasons for the inability to control the pressure of fluidized-bed reactors in pilot plants were analyzed and criteria for calculation of the optimum flow necessary to purify efficiently a porous filter using this procedure were established. (tr-auth)

9059 THE CHEMICAL TREATMENT OF IRRADIATED NUCLEAR FUELS. THE DRY PROCESSES. Faugeras, P. (CEA, Paris). Energie Nucl., 7: 346-53(Sept.-Oct. 1965). (In French).

The chemical treatment of irradiated fuels is necessary, either for the recovery of incompletely burned fuel in the power reactors, or to separate these elements as is the case with reactors producing synthetic elements. Various dry processes for fuel treatment are described, some of which lead to total decontamination, others lead to partial decontamination. Two processes are particularly stressed: the process based on fluoride volatilization for which a pilot plant was constructed at Fontenay-aux-Roses, and the pyrometallurgical process, which is associated with the EBR II American reactor. (auth)

9060 NUCLEAR FUEL REPROCESSING PLANTS IN THE UK. Tuohy, T. EuroNuclear, 2: 539-43(Nov. 1965).

The fuel reprocessing plant built to handle all irradiated fuel from Calder Hall, Chapelcross, and the 5000-Mw civil power program is described. The irradiated fuel storage and de-canning plant, the solvent extraction plant, the thermal denitration facility, the medium-active evaporation and acid recovery plant, and an extension to the existing highly active effluent evaporation and storage plant are involved. Drawings and flow diagrams for the plants are shown. (M.C.G.)

9061 A SIMPLE AIR PULSING TECHNIQUE FOR LIQUID EXTRACTION COLUMNS. Cloete, F. L. D. (Imperial Coll., London). J. Brit. Nucl. Energy Soc., 4: 296-8(Oct. 1965).

A pneumatic pulse generator is described with which small-scale pulsed liquid extraction columns have been operated. (D.C.W.)

9062 SEPARATION OF FISSION PRODUCTS FROM IRRADIATED URANIUM DIOXIDE IN FUSED NITRATE SYSTEMS. Yamagishi, Shigeru; Kamemoto, Yuichiro (Japan Atomic Energy Research Inst., Tokyo). J. Nucl. Sci. Technol., 2: 457-62(Nov. 1965).

The separation of fission products from irradiated uranium dioxide in fused nitrate systems by various methods was studied. (G.O.Y.)

9063 RADIATION DAMAGE TO AMINE EXTRACTANTS. II. EFFECT ON THE EXTRACTION BEHAVIOR OF THORIUM AND PROTACTINIUM. Ishihara, Takehiko; Komaki, Yoshihide (Japan Atomic Energy Research Inst., Tokyo). J. Nucl. Sci. Technol. (Tokyo), 2: 463-7(Nov. 1965).

The effects of radiation damage to alkyl amines diluted with kerosene and modified with lauryl alcohol on their properties for Pa and Th extraction by scrubbing and stripping with nitric acid were investigated. (D.C.W.)

9064 CALCULATION OF THE DISTRIBUTION OF EXTRACTED SUBSTANCE IN INDIVIDUAL STAGES OF AN EXTRACTION APPARATUS IN COUNTER-CURRENT EXTRACTIONS. Sraier, Vratislav (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Rez). Jad. Energ., 11: 296-9(Aug. 1965). (In Czech.).

A review of calculation methods of boundary conditions or distribution of the extracted components in an extraction apparatus in counter-current extractions is given for steady state. (auth)

9065 STUDIES ON METALLIC ZIRCONIUM PRODUCTION FROM ZIRCON. PART 2. DISSOLUTION OF ALKALI FUSION CAKES TO ACID. Jae, Sik Han; Ki, Soon Kim. Kisul Yon'guso Pogo, 3: 54-6(1964). (In Korean).

The decomposition of the fusion cake in acid in the manufacturing process of zirconium was studied. Fifteen milliliters of sulfuric or 50 to 70 ml of hydrochloric acid were sufficient to dissolve a 10 g cake. Crystals of $Zr(SO_4)_2$ and $ZrOCl_2 \cdot 8H_2O$ were obtained in the salt manufacturing process. (auth)

9066 REFINEMENT OF URANIUM BY HORIZONTAL ZONE MELTING AND PROPERTIES OF THE REFINED METAL. Jayne, G.; Cizeron, G.; Lacombe, P. (Ecole des Mines, Paris). Mem. Sci. Rev. Met., 62: 607-17 (Sept. 1965). (In French).

Uranium refined by horizontal zone melting in a boat of sintered UO_2 under a high vacuum was found to be comparable to uranium refined by the moving zone method. The method is easier to apply and gives substantially greater quantities of uranium compared with the moving zone method. (auth)

9067 SEPARATION OF ^{103}Ru AND ^{106}Ru FROM MIXED FISSION PRODUCTS BY SOLVENT EXTRACTION WITH OXINE. Kato, Toyoaki (Tohoku Univ., Sendai). Nippon Kagaku Zasshi, 85: 1054-7(Oct. 1965). (In Japanese).

Oxine can react with ruthenium(IV) in an aqueous acetate solution of pH 4 to 6 by moderate heating, forming a complex extractable into benzene. This extraction technique was applied to the separation of $^{103,106}Ru$ from mixed fission products. Potassium persulfate was used to convert all Ru to the ruthenate state in 6 mol/l NaOH solution of mixed fission products. To this alkaline solution, 4 mol/l HCl–3% H_2O_2 was added to make the final acidity of the solution about 1 mol/l HCl. A 1 mol/l oxine–5 mol/l acetic acid and an aqueous 4 mol/l sodium acetate solution were added. The pH of the resulting solution was adjusted to 4, and the solution was kept at 60°C for 1 hr. An equal volume of benzene was then added, and the mixture was shaken for 1 min. The organic extract was back washed first with aqueous 0.1 mol/l $H_2C_2O_4$ solution to provide ^{95}Zr–^{95}Nb decontamination, and then with dilute acid solution (pH = 1) to remove oxine. Finally, Ru was back extracted into concentrated HCl. The recovery in the extraction step was 92% for Ru, but about 20% loss was caused by the successive back washing steps, therefore the final yield was about 70%. (auth)

9068 URANIUM(VI) EXTRACTION FROM SULPHURIC ACID SOLUTIONS WITH DIALKYLPHOSPHORIC ACIDS SOLUTIONS IN BENZENE OR CARBONE TETRACHLORIDE. Deptula, Czeslaw; Minc, Stefan (Inst. of Nuclear Research, Polish Academy of Sciences, Swierk. Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). Nukleonika, 10: 343-54(1965). (In Polish).

The influence of the concentration of sulfuric acid, uranyl sulfate, and the extractant on the extraction of uranium (VI) with di-n-butyl- and di-2-ethylhexylphosphoric acid solutions in benzene or carbon tetrachloride was investigated. The composition of the extracted compounds was determined and formulas for these compounds are proposed. (auth)

9069 EXTRACTION OF SULPHURIC ACID WITH TRI-N-OCTYLAMINE SOLUTIONS IN BENZENE OR CARBON TETRACHLORIDE. Deptula, Czeslaw; Minc, Stefan (Inst. of Nuclear Research, Polish Academy of Sciences, Swierk. Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). Nukleonika, 10: 355-60(1965). (In Polish).

The influence of the concentration of sulfuric acid and extractant on sulfuric acid extraction with tri-n-octylamine in benzene or carbon tetrachloride was investigated. The degree of hydration of tri-n-octylamine in the organic phase was determined. (auth)

9070 SCANDIUM, YTTRIUM, LANTHANIDES, THORIUM, ZIRCONIUM, AND URANIUM SEPARATION BY ELECTROPHORESIS AND PAPER ADSORPTION AND PARTITION CHROMATOGRAPHY. Guedes de Carvalho, Rodrigo A. (Centro de Estudos de Quimica Nuclear, Porto, Portugal). Rev. Port. Quim. (Lisbon), 6: 57-62 (1964). (In Portuguese).

The R_F in adsorption and partition chromatography was determined and so were the apparent mobilities of lanthanides, scandium, yttrium, zirconium, thorium, and uranium, using as eluents or electrolyte acids or salts containing sulfur (sulfuric acid and sulfates, sulfurous acid and sulfites, sulfamic acid, thiosulfate, dithionate, tetrathionate, dithionite, and thiocyanate). The best conditions for separation of the elements were determined. Attempts to interpret the results and to relate the chromatographical phenomenon with the electrophoretic one were made. (auth)

9071 ON THE OBTENTION OF ^{45}Ca OF HIGH PURITY. Chiotan, C.; Szabo, M. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Chim., 10: 673-6(July 1965). (In French).

Studies were made of the purification of ^{45}Ca from trace impurities of Sr and Ba. For the purification solutions $^{45}CaCl_2$ are passed over a column of $CaSO_4$, which precipitates Sr and Ba. The solutions are then passed over an anionite column to remove the SO_4^{2-} produced in the dissolution of $CaSO_4$ in the first column. (tr-auth)

9072 SEPARATION OF NIOBIUM AND TANTALUM BY REVERSED-PHASE PAPER CHROMATOGRAPHY. Hu, Zhi-tei; Liu, Cheng-li (Lanchow Univ., China). Sci. Sinica (Peking), 14: 1536-7(Oct. 1965).

Experimental results are reported of the complete separation of niobium and tantalum by reversed-phase paper chromatography, using TBP and 20% tannic acid as the stationary phase and a suitable proportion of ammonium thiocyanate, oxalic acid, and hydrochloric acid as the mobile phase. (L.B.S.)

9073 SEPARATION OF URANIUM FROM OTHER METALS BY PARTITION CHROMATOGRAPHY. Fritz, James S.; Schmitt, Donald H. (Iowa State Univ., Ames). Talanta, 13: 123-8(Jan. 1966). (IS-1207).

Uranium(VI) can be separated quantitatively from most other metal ions by partition chromatography on a silica-gel column. The column is treated with aqueous 6M nitric acid; after sorption of the sample, uranium(VI) is selectively and rapidly eluted by methyl isobutyl ketone. In addition to the separation of macro quantities of metal ions, the method was used successfully for the isolation of trace amounts of metal ions from uranium(VI). (auth)

9074 A SEPARATION OF PROTACTINIUM FROM NEUTRON-IRRADIATED THORIUM. Lyle, S. J.; Shendrikar, A. D. (Univ. of Kent, Eng.). Talanta, 13: 140-1 (Jan. 1966).

A method, based on liquid-liquid extraction with N-benzoyl-N-phenylhydroxylamine in chloroform, is given for the separation of ^{233}Pa from neutron-irradiated thorium. (auth)

9075 SORPTION OF ETHYLENEDIAMINETETRA-ACETO COMPLEXES OF RARE EARTH ELEMENTS BY ANION EXCHANGE RESINS. I. KINETICS OF EXCHANGE OF A LANTHANUM COMPLEX WITH CHLORINE ANION OVER AV-17 ANION EXCHANGE RESIN. Khromova, N. P.; Legenchenko, I. A. (Inst. of General and Inorganic Chemistry, Odessa). Ukr. Khim. Zh., 31: 898-907(1965). (In Russian).

The kinetics of exchange of lanthanum complexes with chlorine ions on AV-17 resin was studied in order to develop a method for separation of rare earths. A solution of the tetra-substituted sodium salt of ethylenediaminetetraacetic acid was used for preparation of the lanthanum complex. The exchange duration over AV-17 resin varied from 50 to 400 min, the agitation was varied from 50 to 400 rpm, the resin particle size varied from 0 to 25 to 1.00 to 2.00 mm, and the temperature varied within 15 to 45°C. It was found that except for the initial period of exchange over coarse resin particles, the rate of anion exchange is limited by external mass transfer. In the case of exchange over coarse resin particles (1.00 to 2.00 mm in dia) the process is limited by internal mass-transfer. In the internal mass-transfer region, the overall exchange kinetics is diffusion controlled. (CFSTI)

9076 EXTRACTION OF SCANDIUM NITRATE WITH TRIBUTYL PHOSPHATE. Samodelov, A. P. Zh. Neorg. Khim., 10: 2180-3(Sept. 1965). (In Russian).

The mechanism for the extraction of scandium nitrate from nitric acid solutions using tributyl phosphate was established. In the organic phase the scandium was extracted in the form of the solvate $Sc(NO_3)_3 \cdot 3TBP$. The effect of the concentration of the salting-out agent on the distribution of the scandium was investigated: with increasing charge and decreasing radius of the cation the salting out increased. Substitution of the nitrates of the salting-out agent with acid salts did not affect the distribution of the scandium, which confirmed the conclusions of the determining effect of the cations of the salting-out agent on the energy and configuration. The constant of complex formation of scandium nitrate with tributyl phosphate was evaluated from a comparison of the displacement of the oscillation frequency of the valence bonds P=O for a series of solvates with their thermodynamic constants of complex formation with tributyl phosphate. (tr-auth)

9077 INORGANIC ION EXCHANGERS. Amphlett, C. B. Topics in Inorganic and General Chemistry. A Collection of Monographs. Monograph 2. New York, Elsevier Publishing Co., 1964. 151p. $6.50.

General problems and basic concepts of ion exchange behavior are considered. Ion exchange in clay materials, zeolites, heteropolyacid salts, and hydrous oxides and insoluble salts is discussed. Similarities and differences between different classes of inorganic exchangers and between inorganic and organic exchangers are described. (M.C.G.)

9078 URANIUM EXTRACTION FROM POOR ORES. Bunji, Bela; Vujadinovic, Nenad; Tomic, Dragisa (Engineers Center for Nuclear Raw Materials, Belgrade). 28p. (In Polish). (CONF-207-14). ORINS.

From Second Yugoslavian Polish Symposium on Uranium Technology and Metallurgy, Zakopane, Poland, Sept. 1963.

During the search for an economical approach to uranium separation from poor ores, uranium leaching by passing appropriate solutions through the underground ore was studied. Experimental results with four different samples of ore are presented together with a discussion of factors that may influence the uranium leaching. Results showed that the process generates yields that are slightly smaller (5 to 10%) or equal to those obtained in the agitation process. (JPRS)

9079 URANIUM AND ZIRCONIUM PURIFICATION BY IODIDE METHOD AND ZONAL REFINING. Durkovic, Dragica (Center for Nuclear Raw Materials, Belgrade). 37p. (In Polish). (CONF-207-17). ORINS.

From Second Yugoslavian Polish Symposium on Uranium Technology and Metallurgy, Zakopane, Poland, Sept. 1963.

The technology of the thermal decomposition of iodides was mastered and crystalline iodide zirconium of high purity was obtained under laboratory conditions. The same procedure yielded uranium metal in droplet form. The method of crucibleless zone refining was applied to zirconium, while the uranium metal was refined in crucibles. The feasibility of the removal of numerous metallic impurities from uranium and zirconium is shown. (JPRS)

9080 STARTUP EXPERIENCE FOR THE EBR-II FUEL CYCLE FACILITY. I. MANIPULATORS AND PROCESS AUXILIARIES. Stevenson, C. E.; Paige, D. M.; Holcomb, W. F.; Kleffner, J. O. (Argonne National Lab., Idaho Falls, Idaho). pp 3-7 of Proceedings of the 13th Conference on Remote Systems Technology, 1965. Hinsdale, Ill., American Nuclear Society, 1965.

Argonne National Laboratory is operating pyrochemical fuel processing facilities to process the fuels from the 60 Mw breeder reactor at the Idaho National Reactor Test Station. The facilities consists of two hot cells, one rectangular with an air atmosphere and one annular with an argon atmosphere. Disassembly and re-assembly operations are performed in the air cell and actual fuel reprocessing is performed in the argon cell. This work is accomplished completely remotely using powered manipulators, master slaves, and self-powered machines. Viewing is by large shielding windows and light is provided by mercury vapor lights. The cells have been operated for approximately two years (one year with radioactivity). Some of the experiences are reported. (auth)

9081 STARTUP EXPERIENCE FOR THE EBR-II FUEL CYCLE FACILITY. II. FUEL PROCESSING. Hampson, D. C.; Mitchell, D. L.; Fryer, R. M. (Argonne National Lab., Idaho Falls, Idaho). pp 8-13 of Proceedings of the 13th Conference on Remote Systems Technology, 1965. Hinsdale, Ill., American Nuclear Society, 1965.

Processing of metallic fast reactor fuel from the EBR-II reactor by pyrochemical means was initiated in the Fuel Cycle Facility. Startup of the fuel processing equipment was satisfactory with no major redesign of the equipment required. The problems encountered with sodium acting as a bonding agent and unlubricated metals galling, were mainly due to the lack of inert facilities in which to check the completed equipment. Approximately 18 hours operating time is required to clean, declad, and melt refine the fuel from one subassembly (6.3 kg) received from the reactor. (auth)

9082 FLUID-BED FLUORIDE VOLATILITY PROCESSING OF IRRADIATED FUELS IN A HOT CELL. Chilenskas, A. A.; Turner, K. S.; Holmes, J. T.; Kincinas, J.; Potts, G. (Argonne National Lab., Ill.). pp 25-6 of Proceedings of the 13th Conference on Remote Systems Technology, 1965. Hinsdale, Ill., American Nuclear Society, 1965.

A motion-picture film (16 mm, sound, in color) showing the operation of a fluid-bed fluoride volatility fuel processing unit installed in a hot cell facility at ANL was prepared. The primary objective of the hot cell studies is to obtain information regarding the separation of uranium and plutonium from fission products and the distribution of fission products within the unit. The unit went "hot" in November 1964 and was used to process irradiated highly enriched uranium alloy fuels and irradiated low-enrichment oxide fuels. (auth)

9083 ACTINIDE AND LANTHANIDE SEPARATIONS BY LIQUID-LIQUID EXTRACTION. Peppard, D. F. (Argonne National Lab., Ill.). pp 63-80 of Primera Conferencia Interamericana de Radioquimica. Washington, D. C., Union Panamericana, 1965.

A review is presented of liquid-liquid extraction systems that proved of most use in effecting actinide and/or lanthanide separations. The theoretical aspects of the distribution were confined to stoichiometric considerations. Systems including a neutral extractant, a cationic extractant, and an anionic extractant are considered. (J.S.R.)

9084 AN ION EXCHANGE-EDTA SEPARATION OF LEAD FROM BISMUTH, APPLICATION TO RADIOCHEMISTRY. Abrao, Alcidio (Instituto de Energia Atomica, Sao Paulo, Brazil). pp 89-91 of Primera Conferencia Interamericana de Radioquimica. Washington, D. C., Union Panamericana, 1965.

A procedure for the separation of lead and bismuth is based on the principle that the Bi-EDTA complex is very stable in solutions of relatively low pH whereas lead remains uncomplexed. Bubbling of solutions containing Pb, Bi, and EDTA in a cationic ion exchange resin causes the absorption by Pb by the resin. The Bi ions are eluted as the Bi-EDTA complex. Experimental studies of the method proposed showed that Pb and Bi could be separated with a purity greater than 99% even in experiments where both elements were present at trace levels. (J.S.R.)

9085 INVESTIGATION OF THE METHODS FOR SEPARATION OF PLUTONIUM, URANIUM, AND FISSION PRODUCTS. Cristallini, O.; Rudelli, M. (Comision Nacional de Energia Atomica, Buenos Aires). pp 141-6 of Primera Conferencia Interamericana de Radioquimica. Washington, D. C., Union Panamericana, 1965. (In Spanish).

Various methods for the separation of plutonium, uranium, and fission products are reviewed. The coprecipitation of Pu with $BiPO_4$, LaF_3, and zirconium phenylarsenate, the extraction of Pu with amines of high molecular weight, the extraction of Pu with TTA, extraction of Pu with TBP, and the separation of Pu with ion exchange resins are discussed. (J.S.R.)

9086 PROBLEMS ENCOUNTERED IN THE RECOVERY OF URANIUM ENRICHED FUEL ELEMENTS. Kaufmann, F.; Flegenheimer, J.; Cristallini, O.; Rudelli, M. (Comision Nacional de Energia Atomica, Buenos Aires). pp 147-9 of Primera Conferencia Interamericana de Radioquimica. Washington, D. C.; Union Panamericana, 1965. (In Spanish).

The problems encountered in the recovery of enriched uranium from mixtures composed of aluminum powder with uranium oxide, wastes from the fabrication of fuel elements, analytical residues, and some 40 fuel elements, 16 of which were slightly irradiated, are reviewed. The problems encountered during the recovery were of 2 types. Fast and clear separations between the two phases of the extraction could be obtained only if the solutions were absolutely pure. The Si present in the Al of the fuel elements was apparently the cause of suspensions produced in the dissolution liquid. The other problems encountered were connected with the controls used. These were for the determination of the concentration of ^{235}U in a sample, determination of the pH, U, and Al in the dissolution solution, determination of U in very diluted solutions, and determination of U in pure solutions. (J.S.R.)

9087 SOLVENT EXTRACTION OF SCANDIUM. Arezzo, B.; Danon, J. (Comissao Nacional de Energia Nuclear, Rio de Janeiro. Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). pp 207-10 of Primera Conferencia Interamericana de Radioquimica. Washington, D. C., Union Panamericana, 1965.

The mechanism for the solvent extraction of Sc was studied by measuring the rate of extraction into alcohols of increasing molecular weights from 1-pentanol to 1-octanol diluted to various concentrations with a polar medium such as benzene. The results obtained are tabulated and graphed. These data suggest an interpretation based on the nitrate solvation. This mechanism suggests that the molecule of scandium nitrate would be extracted into the organic phase with 4 water molecules similar to uranyl nitrate and lanthanum nitrate into 1-hexanol. (J.S.R.)

9088 METHOD OF DISSOLVING METALLIC OXIDES AND BORIDES, AND OF EXTRACTING URANIUM VALUES. (to Nuclear Materials and Equipment Corp.). British Patent 1,010,557. Nov. 17, 1965. Priority date Dec. 8, 1961, United States.

A method is described for dissolving a chemically highly stable ceramic consisting of oxides and borides by treating the ceramic in powder form with an aqueous acid solution in the presence of a small amount of Hg or Ag to catalyze the dissolution. The method is particularly applicable to the dissolution of ceramics consisting of one or more of the oxides of U, Be, Zr, and Al and the borides of Zr and Ti with the subsequent recovery of the U by one of the well known solvent extraction procedures. The amount of Hg or Ag added either as the metal or as the salt is not particularly critical, with a concentration of 1 g/l effecting solution in a reasonable length of time and concentrations in excess of 2 g/l not appreciably increasing the speed of reaction. (B.L.M.)

9089 EXTRACTING URANIUM VALUES. (to Nuclear Materials and Equipment Corp.). British Patent 1,010,558. Nov. 17, 1965. Priority date Dec. 8, 1961, United States.

A method of extracting U values from a solution that contains beryllium and U in the hexavalent state consists of adding $Be(NO_3)_2$ to the solution in a sufficient quantity to complex the U and extracting the U as a nitrate with tri-butyl-phosphate or methyl isobutyl ketone. If the U is present in the solution in a lower valence state, it is converted to the hexavalent state before the addition of the beryllium compound. (B.L.M.)

9090 NUCLEAR FUEL PROCESSING. Hartley, Kenneth (to United Kingdom Atomic Energy Authority). U. S. Patent 3,215,492. Nov. 2, 1965. Priority date Mar. 8, 1962, Great Britain.

A method is described for the recovery of fissile material from irradiated fuel materials of the type where the fissile material is in ceramic form and is dispersed in a non-fissile matrix. The bulk fuel is fed to a flame sufficiently hot to melt the matrix, and the heated material is forced through a nozzle so as to form a spray, which is directed upwardly for entrainment in a stream of cool inert gas. The stream of gas containing the particles is conducted to a station where the particulate matter is separated from the gas. (B.L.M.)

ENGINEERING

General

Refer also to abstracts 9311, 9606, and 10280.

9091 (SC-DC-65-1893) AEROSPACE NUCLEAR SAFETY INVESTIGATIONS OF REENTRY ABLATION PHENOMENA. Quarterly Report, August 1–October 31, 1965. Beal, J. L.; Brown, W. R.; Pleuthner, R. L.; Newton, J. F. (Cornell Aeronautical Lab., Inc., Buffalo, N. Y.). Oct. 1965. Contract AT(29-1)-789. 58p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

The size distribution as determined by target impact is given for debris particles formed in a shock tunnel test from excessive sized liquid zirconium drops. Tests of zirconium hydride under reentry conditions simulated in the Mach 6 section of the Wave Superheater Hypersonic Tunnel are described. The determination of emissivity during an ablation test is reported. (auth)

Applications of Nuclear Explosions

9092 (LA-DC-6869) TRANSIENT DIPOLE FIELDS IN TWO SEMI-INFINITE MEDIA. Chang, Julius S. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). [1960]. Contract W-7405-eng-36. 10p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

An approximate solution is presented for the electromagnetic fields from a vertical electric dipole above a plane conducting semi-infinite medium. The Laplace transform of the Hertz vectors in each of the two media are developed and expanded considering the lower medium to be a good but imperfect conductor. The solution follows but extends the classical development by Sommerfeld and subsequently work by Bhattacharyya, Van der Pol, Wait and others. (auth)

9093 (ORNL-3830, pp 271-4) CHEMICAL APPLICATIONS OF NUCLEAR EXPLOSIONS. (Oak Ridge National Lab., Tenn.).

Research and development on selected areas in the Plowshare Program are reported. Emphasis is placed on chemical and metallurgical aspects. Information is included on Project Coach, focusing electrophoresis for separation of heavy elements, development of hypervelocity jet samplers, production of chemicals using nuclear explosives, Project Gasbuggy, and Plowshare applications in Cu and Mg mining. (J.R.D.)

9094 (VUF-1027) GROUND-WATER SAFETY—SALMON EVENT. Project DRIBBLE. Final Report. (Hazleton-Nuclear Science Corp., Palo Alto, Calif. Earth Sciences Div.). Oct. 1, 1965. Contract AT(29-2)-1229. 25p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

Evaluations, predictions, and recommendations for ground-water safety were made for the 5 kiloton Salmon Event, Project Dribble. Pre-shot consideration indicated that the nuclear explosion would be fully contained within the salt mass of Tatum Dome, enabling the conclusion that radiocontamination of aquifers intersecting or overlying Tatum Dome would not occur. In the unlikely event that contaminants were introduced into aquifers it was estimated that contaminant movement within the aquifers would be limited to a maximum lateral distance of about 700 meters from the point of insertion before reduction to acceptable concentrations by radioactive decay. Shot and post-shot data indicate that the Salmon underground nuclear event was essentially contained within the salt matrix of Tatum Dome and no explosion radioactivity was detected in the aquifers. Recommendations are made for future sampling and monitoring of all aquifers previously considered to assure continuing ground-water safety. (auth)

Facilities and Equipment

Refer also to abstract 10320.

9095 (NYO-3237-3) EXPERIMENTAL TEST AND EVALUATION OF A GAS-BEARING BRAYTON CYCLE TURBOCOMPRESSOR. Progress Report for Quarters March 1–May 31, 1965; June 1–August 31, 1965. Curwen, P. W.; Schwarz, H. (Mechanical Technology Inc., Latham, N. Y.). Sept. 22, 1965. Contract AT(30-1)-3237. 121p. (MIT-65TR53). Dep. mn; CFSTI $4.00 cy, $0.75 mn.

The feasibility of, and problem areas associated with, the application of gas-lubricated bearings to closed-system gas-turbine machinery are investigated. A Brayton-cycle gas generator (turbocompressor) utilizing self-acting gas bearings is designed and built, and is under test. Self-sustained closed-loop operation of the turbocompressor, using its own cycle gas as the bearing lubricant, is achieved. The turbocompressor operations include tests at 1300°F (design point) turbine inlet temperature, at 24,000 rpm (design point) rotor speed, at 15 psia (design point) and 20 psia compressor inlet pressure, at compressor inlet temperatures from 70 to 135°F, at 2.01 (design point) compressor pressure ratio, and under compressor surge conditions. Problem areas are identified with respect to turbocompressor performance. (auth)

9096 (SC-DR-65-568) ULTRASTABLE COMPONENT OVENS. Kannolt, J. R. (Sandia Corp., Albuquerque, N. Mex.). Dec. 1965. Contract AT(29-1)-789. 58p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

Economical component ovens were designed to control the temperature environment of electronic packages to a very close tolerance over an ambient temperature range of 15 to 40°C. Over this ambient range the tolerance is ±0.025°C from a set operating temperature. Operating temperature of the single-cavity oven is 51 ± 0.25°C and 53 ± 1°C for the larger five-cavity oven. At a constant ambient the tolerance is ±0.005 from a set operating temperature. Each cavity has a volume of 2.85 cubic inches. The cavities are shielded against stray magnetic fields and the windings of the dual heaters are bifilar wound. Although an ON-OFF-type control is used, changes in cavity field intensity were measured to be less than 0.0005 gauss during the OFF-to-ON transition. A nine-pin miniature tube socket is mounted at the center of the base of each cavity. Data from performance testing 22 single-cavity ovens and 11 five-cavity ovens are presented. (auth)

9097 (TID-21719) REMOTE HANDLING OF MOBILE NUCLEAR SYSTEMS. Layman, Douglas C.; Thornton, Gunnar (General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation). [1965]. Contract AT(40-1)-2847. 655p. Dep. mn; CFSTI $4.50 cy, $2.75 mn.

Technology developed during the Aircraft Nuclear Propulsion program is described. Information is given on: nuclear systems and the Idaho Test Station; remote-handling procedures and support equipment; general-purpose facilities and tools; facilities and equipment in the shop building; related services; mechanical parts; shielding calculations; radiation effects; and health physics. Data on specification for a hot-shop wall-mounted boom and manipulator, specifications for radioactive core service area wall-mounted boom, remotely handled electrical connector, methods of calculating induced activity, and radiation calculations are appended. (P.C.H.)

9098 (Y-1498) EVALUATION OF A DUPLICATOR LATHE WITH HYDROSTATIC BEARING SLIDES AND AN

ELECTROHYDRAULIC CONTROL SYSTEM. Richards, J. B. (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). Aug. 26, 1965. Contract W-7405-eng-26. 24p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

An American 25-inch duplicator lathe was modified with hydrostatic slides and an electrohydraulic control system. Test procedures were developed and results were obtained that compare its performance with a conventional machine. (auth)

9099 A CONCRETE LOW-BACKGROUND COUNTING ENCLOSURE. Wollenberg, Harold A.; Smith, Alan R. (Univ. of California, Berkeley). Health Phys., 12: 53-60 (Jan. 1966).

A massive concrete low-background γ-ray counting enclosure was recently constructed at the Health Physics Department, Lawrence Radiation Laboratory (University of California), Berkeley. Walls and roof are 4 to 5 ft thick; inside dimensions are 23.5 × 11.5 × 11.5 ft. A substantial effort was made to secure materials adequately low in radioactivity for the concrete. An examination was conducted of possible sources of low-radioactivity aggregate material; samples were analyzed for radioactivity on a 100-channel γ-ray spectrometer. Evaluation of the spectrometer analyses and economic considerations resulted in the choice of serpentinized ultramafic rock from a deposit in the foothills of the Sierra Nevada as the source of low-background aggregate. Raw materials from twelve portland cement plants in California, and finished products from 114 plants in the United States and Canada, were also examined for radioactivity by γ-ray spectrographic analysis. The completed enclosure furnishes a nearly twofold reduction in background in comparison with the previous counting arrangement. Equally important, the thick concrete shield with its included water of hydration keeps the present level of radioactivity non-fluctuating, whereas the background in the previous counting arrangement varied in proportion to the external fast-neutron flux produced by nearby accelerators. A comparison of costs indicates that to shield a similar-sized counting space with steel of equivalent attenuation and low-background characteristics would cost (in place) about four times as much as the existing concrete structure. (TCO)

9100 A CLASSIFICATION OF LABORATORIES FOR USE OF NON-CONFINED RADIOACTIVE MATERIALS. Thomas, John W.; Hale, John (Univ. of Pennsylvania, Philadelphia). Health Phys., 12: 96-8 (Jan. 1966).

A classification consisting of laboratory type vs. use-amounts of non-confined radioisotopes is presented. Special design details are summarized for four laboratory types according to activity level: very low level, low level, medium level, and high level laboratories. The classification is a valuable aid in communicating with architects, engineers, maintenance personnel, and others. It also provides a convenient basis for the evaluation of existing facilities. (H.G.D.)

9101 MULTICURIE GAMMA IRRADIATION FACILITY. DESIGN AND REALIZATION. Morris, J.; Penhale, L. G. (Royal Military Coll. of Science, Shrivenham, United Kingdom). Nucl. Eng., 10: 469-71 (Dec. 1965).

The design and operation of a ^{60}Co irradiation facility intended for research purposes are discussed. The source was initially 2500 C and was later recharged with 8000 C ^{60}Co. The design of the lead and heavy-alloy source container, the electric motor for raising the source out of the container, and the walls and entrance of the large exposure cell is explained. Transport and assembly of the source jig and container, safety instrumentation and procedures, and realization and operation, including an incident in which the shutter over the source failed to close, are described. (M.J.T.)

9102 PROCEEDINGS OF THE 13th CONFERENCE ON REMOTE SYSTEMS TECHNOLOGY, AMERICAN NUCLEAR SOCIETY WINTER MEETING, NOVEMBER 15–18, 1965, WASHINGTON, D. C. Hinsdale, Ill., American Nuclear Society, 1965. 208p. (CONF–651101).

Papers presented at the 13th Conference on Remote Systems Technology are given. Separate abstracts were prepared for 26 papers. Seventeen papers were previously abstracted for NSA and appeared as 19: 36590, 43936, 44167, 44168, 46506, 46509, 46644, 46711, 46712, 46721, 47159, 47975, and 48055 and 20: 476, 477, 622, and 5136. (M.C.G.)

For abstracts of individual papers see: 9017, 9018, 9039, 9080–9082, 9103–9106, 9121–9126, 9212–9214, 9235, 9402, 9403, and 9470–9473.

9103 AN EXPERIMENTAL HEAD-CONTROLLED TV SYSTEM TO PROVIDE VIEWING FOR A MANIPULATOR OPERATOR. Goertz, Ray; Potts, Charles; Mingesz, Don; Lindberg, J. F. (Argonne National Lab., Ill.). pp 57-60 of Proceedings of the 13th Conference on Remote Systems Technology, 1965. Hinsdale, Ill., American Nuclear Society, 1965.

An experimental television positioning system was built and tested at ANL in which the pan and tilt motions of the camera and monitor are slaved to follow the corresponding motions of the manipulator operator's head. The operator is free to move a limited amount in any direction but only the "pan and tilt" motions of his head control movements of the monitor or camera. In order to obtain a television picture with useful resolution only a 30° camera viewing angle is used. The television positioning system devised allows operators to move this small cone of view about quickly and easily and thereby carry out remote tasks within a much larger volume. (auth)

9104 HOT LABORATORY OF JAPAN ATOMIC ENERGY RESEARCH INSTITUTE. Murakami, M.; Iso, Y.; Sasaki, Y.; Hayashi, K.; Matsumoto, T.; Sakakura, A.; Tomimura, K. (Japan Atomic Energy Research Inst., Tokai-mura). pp 75-86 of Proceedings of the 13th Conference on Remote Systems Technology, 1965. Hinsdale, Ill., American Nuclear Society, 1965.

Construction was started in 1959 on JHL-1 of the Hot Laboratory, and it was completed in 1961. JHL-1 was expanded in the period of 1963 to 1964. This expansion, called JHL-2, was completed at the beginning of 1965, and installation of the in-cave equipment and facilities was finished the end of August 1965. JHL-1 is used in the development of various types of nuclear fuels, including UO_2, while JHL-2 will be used to monitor fuel elements of the Tokai (atomic) power station, and to examine the spent fuels from The Japan Research Reactor (JRR-2), JRR-3, and The Japan Power Demonstration Reactor (JPDR). JHL-1 and JHL-2 are described and the design philosophies for these caves discussed. Equipment and facilities are also described, including partition doors with a pneumatic drive system, conveyors installed in the concrete and lead cells, the wireless remote control crane, pneumatic tubes, and pneumatic butterfly valves for the ventillation system. (auth)

9105 REMOTELY OPENING METAL CONTAINERS WITH A LASER BEAM. Horrocks, Donald L.; Studier, Martin H. (Argonne National Lab., Ill.). pp 161-3 of Proceedings of the 13th Conference on Remote Systems Technology, 1965. Hinsdale, Ill., American Nuclear Society, 1965.

A method was developed for remote opening of metal containers by focusing the beam of light from a laser through a lens onto the metal container, which can be inside a closed system or behind a protective wall. It was demonstrated that the laser beam could be directed around corners by the use of mirrors or prisms. Advantages and problems associated with this technique are discussed. (M.C.G.)

9106 SPECIAL APPLICATION FOR THE BAUSCH AND LOMB DR-25B OPTICAL GAGE REMOTE MEASURING SYSTEM. Renzi, E. P. Jr. (Knolls Atomic Power Lab., Schenectady. N. Y.) pp 167-8 of Proceedings of the 13th Conference on Remote Systems Technology, 1965. Hinsdale, Ill., American Nuclear Society, 1965.

An optical gage was equipped with a remotely operated

stage to measure rectangular or round tensile test samples. The vertical and vernier scales are simultaneously projected onto a ground glass screen by an optical readout system. The system permits direct readings to the fourth decimal place and allows a very good estimate of the fifth decimal place. (M.C.G.)

9107 METHOD FOR TRANSFERRING A SPECIMEN HOLDER INTO ITS CONTAINER, AND THE STRUCTURE OF THE CONTAINER. Inou, Kazuo (to The Uraga Heavy Ind., Ltd.). Japanese Patent 1964-23459. Oct. 21, 1964. Filed July 11, 1962.

The method and container proposed are used for transferring a specimen holder with an irradiated specimen into the container from the reactor irradiation hole; the container, adequately shielded, is suitable for transporting the irradiated specimen to the laboratory. The specimen holder is placed near the reactor core in the irradiation hole; it is then attached to the end of a long tube, which connects the holder to the hole plug. When removing this holder with an irradiated specimen after irradiation, the disconnection of the holder from the tube and the closing of the container after containment are done at the same time. The container for this purpose consists of a gear system for closing (or opening) the lid, two cutters installed on the inner side of the lid, and a device for working the two cutters simultaneously. The entire transport container with shielding is divided into two parts put together by means of female and male cones. (NSA of Japan)

9108 IRRADIATION METHOD. Shigeta, Michio (to Hitachi, Ltd.). Japanese Patent 1964-23460. Oct. 21, 1964. Filed Oct. 27, 1962.

The irradiation method proposed employs a radioisotope as the radiation source, and is very useful when irradiating materials in the shape of a long belt or wire. The roller, which conveys or guides the materials, contains a radioactive material for the irradiation. (NSA of Japan)

9109 FLUID-TIGHT PIPE JOINT HAVING A CAMMED FLEXIBLE LIP. Peuchmaur, Alphonse (to Commissariat a l'Energie Atomique). U. S. Patent 3,214,198. Oct. 26, 1965. Priority date Aug. 9, 1961, France.

A device for fluid-tight connection between two tubular elements includes cooperating means on the two elements consisting of an annular axially directed radially deformable lip integral with and thinner than one of the elements that fits into a bore defined by the other element. An annular rigid means independent of the elements having a radially outer surface frustoconical along at least a part of its length is axially engagable within the lip and is of such radial dimension as to force part of the outer surface of the lip outwardly into sealing engagement with the inner surface of the other element. Radial clearance is provided between the radially outer surface of the thin annular terminal lip and the confronting inner surface of the other element. A lock ring shorter than the lip is secured to one of the elements within the radial clearance to act as a stop for the other of the elements. A radial shoulder for the other element cooperating with the lock ring engages an intermediate portion of the outer surface of the lip after it has been expanded to form a seal. The elements must have different coefficients of thermal expansion, and the annular means and the element defining the bore have the same coefficient. (B.L.M.)

9110 REMOTE-CONTROL MANIPULATOR. Ainsworth, Alan (to United Kingdom Atomic Energy Authority). U. S. Patent 3,219,200. Nov. 23, 1965. Priority date May 7, 1962, Great Britain.

A remote-control manipulator comprises two tubular beam casings axially slidable and rotatable relative to each other defining a transverse extensible beam. Shoulder joints are located at each end of the beam, and a master arm and slave arm are pivotally connected to the beam at respective shoulder joints. The hand grip is carried by the master arm; while the work handler is carried by the slave arm, and the work handler includes telescopic rotary connecting rods extending axially of the beam between the shoulder joints. The two beam casings may be relatively rotated to permit lateral displacement of the slave arm relative to the master arm. A fluid pressure operated ram is connected between the two casings to cause relative axial displacement of the two beam casings to cause transverse displacement of the handler relative to the hand grip. (B.L.M.)

Heat Transfer and Fluid Flow

See also PHYSICS — Fluid Physics and Thermodynamics

Refer also to abstracts 10268, 10270, 10279, 10281, and 10351.

9111 (AE–201) HEAT TRANSFER ANALOGIES. Bhattacharyya, Ajay (Aktiebolaget Atomenergi, Stockholm (Sweden)). Nov. 1965. 66p. Dep. mn.

Descriptions of various analoges used to study different steady-state and unsteady-state heat transfer problems are given. The analogs covered are: hydraulic; membrane; geometric electrical; and network. A comparison of the different analogs is presented in the form of a table. 81 references are cited. (auth)

9112 (ANL–7053) PROPAGATION OF DENSITY DISTURBANCES IN AIR-WATER FLOW. Nassos, George P. (Argonne National Lab., Ill.). June 1965. Contract W-31-109-eng-38. 115p. Dep. mn. CFSTI $4.00 cy, $0.75 mn.

The behavior of density waves propagating vertically upwards in an atmospheric-pressure air-water system was investigated. A square-wave pattern was imposed on the solenoid valve controlling the secondary air flow, resulting in a regular sequence of density disturbances. Two air-water mixers were used for producing the primary air-water flow and the secondary perturbations. Twenty runs were made in which the steady-state air flow, the perturbation air flow, and the liquid velocity were varied. A plot of computer results depicted qualitative agreement with the kinematic wave theory. A comparison of the experimental propagation velocity with predictions from the kinematic wave theory showed fairly good agreement, but there was a tendency, at low mixture velocities, for the experimental velocity to be greater than the theoretical velocity; for large mixture velocities, the reverse was true. A comparison of the experimental decay rate with that predicted by the kinematic wave theory showed, in general, a perturbation decay rate considerably higher than predicted. Steady-state data were plotted on a V_g-versus-V_m plane, and the points, in general, could be described by a straight line with a slope of $C_0 = 1.1$ and an intercept of $V_d = 0.7$ ft/sec. This value of C_0 would indicate flat velocity and concentration profiles, while experimental data showed concentration profiles described by a one-third or one-fourth power law distribution. The time-averaged transient data were also plotted on a V_g-versus-V_m plane resulting in a rather straight line with a slope of $C_0 = 1.2$ and $V_d = 1.0$ ft/sec. The difference between the steady-state data and time-averaged transient data may be attributed to the fact that $dC_0/dt \neq 0$, and that both C_0 and V_d may be functions of the mixture velocity. (P.C.H.)

9113 (BAW–3238-10) NONUNIFORM HEAT GENERATION EXPERIMENTAL PROGRAM. Quarterly Progress Report No. 9, July–September 1965. (Babcock and Wilcox Co., Lynchburg, Va. Atomic Energy Div.). Contract AT(30-1)-3238. 61p. (EURAEC–1483). Dep. mn; CFSTI $3.00 cy, $0.75 mn.

Work Performed under United States–Euratom Joint Research and Development Program.

Data are obtained on four tubular test sections. One has uniform flux to serve as a reference condition, and three have nonuniform axial heat flux to show the effect of flux distribution on critical heat flux conditions. Empirical correlations are developed to express mathe-

matically the effects of the various operating variables on critical heat flux. Data are given for two annular test sections. In the first case the inside surface is heated, and in the second case the outside surface is heated. The data are reviewed, and a preliminary analysis is presented. For the same conditions of pressure, mass velocity, and inlet temperature, the annular test sections with one surface heated produce critical heat fluxes that are higher than those in the tubular test sections. (auth)

9114 (TID–22496) CRITICAL HEAT FLUX IN LONG TUBES AT 1000 PSIA WITH AND WITHOUT SWIRL PROMOTERS. Topical Report No. 4. Matzner, B.; Casterline, J. E.; Biderman, R. (Columbia Univ., New York. Engineering Research Labs.). Feb. 4, 1965. Contract AT(30-3)-187. 43p. ORAU.

Critical heat flux in long uniformly heated tubes and without swirl promoters was investigated. Over 200 critical heat flux points and over 400 two-phase pressure drop points were obtained for six electrically heated test sections with vertical upflow of boiling water at 1000 psia. The three axial flow test sections had heated lengths of 8, 12, and 16 ft. Of the three swirl flow test sections, one with a 16 ft. heated length employed a full length twisted tape while the other two with heated lengths of 12 and 16 ft used 2 in. long tape segments installed one each at the inlet and 8 ft downstream of the inlet. The ranges of experimental variables covered were: mass velocities between 1 and 7×10^6 lb/hr-ft^2, exit qualities between 1 and 88% and critical heat fluxes as high as 1.3×10^6 Btu/hr-ft^2. The major conclusion of these tests was that properly designed swirl promoters have the potential for substantially increasing the critical heat flux inside tubes without requiring extra pumping power. (auth)

9115 (ANL-Trans-236) ON THE MEASUREMENT OF TEMPERATURE DISTRIBUTION ALONG HEAT CONDUCTING WALL UNDER TRANSIENT BOILING. Takeuchi, Kiichiro. Translated for Argonne National Lab., Ill., from Doshisha Daigaku Rikogaku Kenkyu Hokoku, 5: No. 2, 82-97(Oct. 1964). 18p. Dep. mn; JCL $1.10 fs, $0.80 mf.

Studies were made to clarify the mechanism of burnout and establish a basic method of correlating burnout heat fluxes with the heat transfer coefficient. Methods for measuring temperature distribution along a heat conducting wall, which is needed to compute heat transfer coefficients of the transient boiling region where perhaps burnout phenomena occurs, were investigated. Experimental results with thermo-couples one with Multi Wheatstone Bridge are discussed. These experiments were carried out with step heat input to the heat generator in a vertical circular tube, which is as large as fuel rods of the reactor. The accuracy of the results is within about ±5%. (auth)

9116 LIQUID VOLUME FRACTION IN TWO-PHASE ADIABATIC SYSTEMS. Cravarolo, L.; Hassid, A. (CISE, Milan). Energia Nucl. (Milan), 12: 569-77(Nov. 1965).

The main results are presented of an experimental investigation on liquid volume fraction in two-phase, (gas + liquid) adiabatic system of argon-water and argon-ethyl alcohol. Annular-dispersed and bubble flow regimes were mainly studied. The experiments were performed through various methods based on different principles which are briefly reviewed. The results allow the dependences of liquid volume fraction upon the following parameters to be outlined: specific mass flow rate, quality, gas density, surface tension, and diameter. An empirical correlation was derived for liquid volume fraction in circular geometry; this correlation is discussed and compared against the available data. (auth)

9117 HEAT TRANSFER BY SLUG FLOW IN ANNULUS. Michiyoshi, Itaru (Kyoto Univ.); Matsumoto, Ryuichi. J. Nucl. Sci. Technol. (Tokyo), 2: 468-75(Nov. 1965).

An analysis of heat transfer by slug flow in an annulus with different heat fluxes at the two wall surfaces is presented. The local Nusselt numbers at each wall surface are calculated. The results show that the local Nusselt number varies with the ratios of the radii and of the wall heat fluxes. Heat transfer in a circular tube and between two parallel plates is also discussed. (D.C.W.)

9118 A STUDY ON THE BOILING HEAT TRANSFER FROM FLAT SURFACE UNDER HIGH HEAT FLUX. (THE EFFECT OF SURFACE INCLINATION ON NUCLEATE BOILING AND BURNOUT HEAT FLUX). Kiwaki, Jumei; Morita, Toshiki (Kobe Univ. Mercantile Marine, Japan). Kobe Shosen Daigaku Kiyo. Dai-2-Rui. Kokai, Kikan, Rigaku-hen, No. 12, 51-8(Mar. 1965). (In Japanese).

In an investigation of the effects of surface inclination on boiling heat transfer, the variation of the boiling curves and burnout heat flux for water was experimentally determined by changing the surface angle at atmospheric pressure. When the surface angle approached the downward horizontal, the process of vapor–bubble formation and its removal was different from the process when the surface was upward and vertical, and the burnout heat flux decreased. But the shape of boiling curves was similar to that of the curves shown when the surface was upward and vertical and wires were electrically heated. (auth)

9119 IMPROVEMENTS IN OR RELATING TO HEAT EXCHANGERS. Taylor, Peter Anthony (to Babcock and Wilcox Ltd.). British Patent 1,010,471. Nov. 17, 1965. Filed Jan. 19, 1961.

A heat exchanger is made up of a bank of tubes of equal bores arranged for the flow in parallel through them of a vapor, gas, or liquid. The lengths of the tubes of the bank are varied for the effective utilization of the space for accommodation of the tube bank, and the cross sectional areas of the flow paths in the tubes are smaller for shorter tubes than for longer tubes. The bank of tubes is arranged in a cylindrical pressure vessel, and the tube lengths extend transversely of the vessel. (B.L.M.)

Materials Testing

9120 (APDA–178, pp 50-63) UNDER SODIUM SCANNER. Ying, Shuh-pan (Atomic Power Development Associates, Inc., Detroit, Mich.).

The ultrasonic transducers worked satisfactorily in liquid sodium at temperatures up to and including 600°F. Three piezoelectric materials; X-cut quartz, lead metaniobate, and lead zirconate–titanate, were used. Of the three materials, the lead zirconate–titanate performed best at 600°F. The measurements of ultrasonic attenuation in liquid sodium were completed over the temperature range of 220 to 600°F. The experimental data were compared with the values calculated from the classical theory on relaxation in liquid. Conceptual designs of two practical methods for viewing objects immersed in sodium are summarized. (M.O.W.)

9121 THE REMOTE DETERMINATION OF GAS PRESSURE VOLUME FOR ENCAPSULATED FUEL ELEMENTS. Mahagin, D. E.; Feldman, M. J. (Argonne National Lab., Idaho Falls, Idaho). pp 36-9 of Proceedings of the 13th Conference on Remote Systems Technology, 1965. Hinsdale, Ill., American Nuclear Society, 1965.

A device that permits remote determination of gas pressure and void volume within encapsulated fuel elements was developed and is being used in the Fuel Cycle Facility at EBR-II. Gas pressures are measured directly by venting the capsules into a small chamber of known volume. In a separate sequence of operation, the void volumes are determined by expanding carefully controlled amounts of helium into the elements. Experimental data indicate that the apparatus is highly sensitive. In addition, it appears to be reliable and suited to remote operation. (auth)

9122 REMOTELY OPERATED TEST EQUIPMENT FOR MATERIALS TESTING IN COMBINED CRYOGENIC AND NUCLEAR RADIATION ENVIRONMENT. Weleff, W.;

McQueen, H. S. (Aerojet General Corp., Sacramento, Calif.). pp 44-7 of Proceedings of the 13th Conference on Remote Systems Technology, 1965. Hinsdale, Ill., American Nuclear Society, 1965.

The major design features of remotely operated test equipment for testing of materials in a combined environment of liquid hydrogen and nuclear radiation are described. This equipment consists of tensile pulling assemblies, cryostats, pneumatic and hydraulic systems, and the necessary instrumentation. Comments on operating procedures are included. The equipment was utilized to determine tensile properties of various alloys in this environment. (auth)

9123 DEVELOPMENT OF PHOTOGRAMMETRIC TECHNIQUES FOR MEASURING SURFACE CONTOURS OF SMALL SAMPLES. Solomon, Y. (Bettis Atomic Power Lab., West Mifflin, Pa.); Bohn, S. W.; Dimond, W. J. pp 48-51 of Proceedings of the 13th Conference on Remote Systems Technology, 1965. Hinsdale, Ill., American Nuclear Society, 1965.

Photogrammetric techniques were developed for precision measuring of irradiated samples to ±0.00005 in. (50 μin.). Such techniques were earlier developed for measuring earth contours from stereophotographs. Stereophotographs were taken of two objects of different heights (above a reference plane) with a remote stereomicroscope. The resulting negatives were then printed, enlarged, and projected on a flat surface. Measurements of parallax from the projection allowed height difference determination. (auth)

9124 THE BABCOCK AND WILCOX HOT CELL FACILITY. Womack, Robert E. (Babcock and Wilcox Co., Lynchburg, Va.). pp 87-91 of Proceedings of the 13th Conference on Remote Systems Technology, 1965. Hinsdale, Ill., American Nuclear Society, 1965.

The Babcock & Wilcox Company Hot Cell Facility was designed to provide a shielded environment for postirradiation examination of experimental reactor fuels and components varying in size from capsules to power reactor elements. The original cell, which began "hot" operation early in 1964, was supplemented with two smaller kilocurie capacity cells. (auth)

9125 INERT ATMOSPHERE ENCLOSURE FOR ENVIRONMENTAL TESTING. Ludlow, J. O.; Coleman, L. F.; Malecha, R. F.; Schraidt, J. H.; Slawecki, M. A. (Argonne National Lab., Ill.). pp 129-37 of Proceedings of the 13th Conference on Remote Systems Technology, 1965. Hinsdale, Ill., American Nuclear Society, 1965.

Operations in the Experimental Breeder Reactor II Fuel Cycle Facility in Idaho disclosed a number of process and equipment problems attributable to operation in a dry argon environment. To simulate the atmospheric conditions in the Fuel Cycle Facility, an inert-atmosphere enclosure for environmental testing of equipment and processes was constructed. The enclosure was constructed of structural steel beams and $\frac{1}{8}$-in. steel plate and contains 29 windows with four glove ports each. The steel plates were skip-welded to the support beams and the joints sealed with epoxy adhesive. Since only innocuous materials are processed in the enclosure, it is operated at a positive pressure, thus minimizing contamination of the enclosure atmosphere by inleakage of air. Three months of operating experience showed the reliability of the enclosure system. The argon atmosphere was maintained at its designed purity, containing 5 ± 1% nitrogen and 40 ± 20 ppm each of oxygen and water. The enclosure cost $50,000, exclusive of the gas purification system. The cost of argon to replace that leaking from the enclosure and auxiliary appurtenances amounts to less than $0.25/hour. (auth)

9126 A REMOTE MICROHARDNESS TESTER. Cochran, F. L.; Wallace, W. P.; Shoemaker, H. E. (General Dynamics Corp., San Diego, Calif.). pp 172-4 of Proceedings of the 13th Conference on Remote Systems Technology, 1965. Hinsdale, Ill., American Nuclear Society, 1965.

A hardness tester for use in remote operations at the General Atomic High Radiation Laboratory is described. The most accurate and reproducible test-block indentations were made using a 20X objective and a 200, 500, or 1000-g load. The periscope, weight system, and indenter are described. Sample preparation and operation are discussed. (M.C.G.)

Protective Structures

Refer also to abstract 10220.

Space Propulsion

See also ISOTOPE TECHNOLOGY — Power Application
REACTOR TECHNOLOGY — Propulsion and Space

Refer also to abstract 9613.

9127 (NASA-TN-D-3194) MANNED MARS LANDING MISSIONS USING ELECTRIC PROPULSION. MacKay, John S.; Zola, Charles L.; Rossa, Leonard G.; Fishbach, Laurence H.; Strack, William C.; Hrach, Frank J. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Jan. 1966. 28p. CFSTI $2.00 cy, $0.50 mn.

Estimates of the initial mass required in low Earth orbit to land four men of a seven-man crew on Mars are presented for a variety of mission profiles. The exploration time is 40 days, while the mission time is varied between 400 and 700 days. The initial mass is used as the main criterion of merit and is presented as a function of mission time. Payload estimates include weight allowances for shielding the crew against solar flares, cosmic rays, and the Earth's inner Van Allen belt. Of the various mission profiles studied, it appears essential that an initial high-altitude rendezvous maneuver be used prior to Earth escape in order to avoid a slow manned traversal of the inner Van Allen belt. This procedure reduces the required crew shield weight, and also shortens the time that the crew is away from Earth. Atmospheric braking at Earth return can also give a large weight saving, particularly for the higher entry velocities. A profile with atmospheric braking at Earth return coupled with unmanned traversal of the Van Allen belts was used for several sensitivity studies. These studies show that the ability of the crew to recover from a given radiation dose is as important as the maximum allowable dose. Rapid weight increases were also noted as a result of changes in specific impulse at high values of powerplant specific mass or reductions in power below the optimum design value. As part of the sensitivity study the thrustor efficiency is varied for constant thrust. Also, a comparison is made with the ideal variable thrust. A study of these results shows that most of the weight penalty associated with constant thrust operation is due to thrustor inefficiency rather than the inability to vary the thrust. Finally, a comparison is made between the all-electric rocket system and two alternative systems. One of these systems is a typical high-thrust nuclear-rocket system. The other is a combined system that uses high-thrust chemical or nuclear rockets to depart Earth and an electric rocket for the rest of the mission. This comparison shows that a combined system of a nuclear rocket to assist an electric system that requires 7 kg/kw of power is superior to both the all-nuclear and all-electric systems over the entire range of mission times studied. Also, a comparison of the power and mass requirements for the combined system shows that the electric portion could also serve as an all-electric system at a longer mission time. (NASA)

9128 (NASA-TN-D-3197) RADIANT HEATING OF A SEEDED GAS IN A COAXIAL-FLOW GASEOUS REACTOR.

Masser, Charles C. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Jan. 1966. 24p. CFSTI $1.00 cy, $0.50 mn.

A theoretical analysis was made to determine how effectively a seed material can heat hydrogen propellant in a coaxial-flow gas-core reactor. It was assumed that the seed material was spherical and that the heat-transfer mechanism was radiation from the hot gas core to the spherical particles and conduction from the particles to the surrounding hydrogen gas. The following ranges of conditions were used: particle diameters from 0.05 to 1.00 micron; power outputs of the gas core from 3195 to 10,097 Mw per foot of core length, which correspond to surface blackbody temperatures of 30,000 and 40,000°R, respectively; constant density and specific heat corresponding to 500 atmospheres and 5500°R for the hydrogen propellant; and three values of hydrogen gas thermal conductivity corresponding to temperatures of 2900, 5500, and 8000°R. It is concluded that the difference in temperature between the particle and bulk gas is such that the propellant-seed mixture can be treated as a continuous gray gas. (auth)

9129 (SC-R-65-1023) PERFORMANCE AND APPLICATIONS OF A MINIATURE ROLL STABILIZED GYRO PLATFORM. Sinnott, N. F.; Rasmussen, R. O. (Sandia Corp., Albuquerque, N. Mex.). Oct. 1965. Contract AT (29-1)-789. 9p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

A new gyroscopic attitude reference device, called a Roll Stabilized Gyro Platform or Miniature Attitude Reference System, was developed for use on spin stabilized rocket vehicles. The construction and design of the system is described, followed by a discussion of error factors and over-all accuracy of the system. This new gyro system fills the void between low cost standard free gyro assemblies and the sophisticated but costly inertial platform systems. It offers additional performance features that are useful in telemetry applications which are described. Several examples are discussed, of how the roll stabilized gyro platform functioned in typical flight tests of spinning rocket vehicles. (auth)

9130 (UCRL-7644) THE FLOSS IV COMPATIBLE PROGRAMS, INCLUDING PROCEDURES FOR THE REAL GASDYNAMIC, ONE-DIMENSIONAL PERFORMANCE ANALYSES OF NUCLEAR RAMJET AND ROCKET ENGINES. Mintz, Michael D. (Lawrence Radiation Lab., Univ. of California, Livermore). Sept. 28, 1965. Contract W-7405-eng-48. 127p. Dep. mn. CFSTI $4.00 cy, $1.00 mn.

The aerothermodynamic behavior of compact heat exchangers as applied to vehicle propulsion systems is analyzed in terms of compatible one-dimensional models of the various system components. The methods of calculation are presented by means of simple logic flow diagrams which are based upon real gas properties and processes. The described methods are incorporated in a versatile digital computer program which computes total system aerothermodynamic performance, subject to a number of input options relating to overall system boundary conditions and heat exchanger design criteria. A complete FORTRAN II code listing and instructions for operation are presented for this program. The code is memory-contained and has been run on both the IBM 7090 series and CDC 3600 and 6600 digital computers. (auth)

9131 CONTINUOUS MEASUREMENT OF SOLID PROPELLANT BURNING RATES. Osborn, J. R.; Burick, R. J.; Panella, R. F. (Purdue Univ., Lafayette, Ind.). Rev. Sci. Instrum., 37: 86-92(Jan. 1966).

An experimental system is presented for the direct and continuous measurement of the burning rates of solid rocket propellants under conditions closely approximating those of a solid rocket motor. The system involves a positioning type servomechanism which moves a sample of solid propellant within a two dimensional rocket motor such that the receding burning surface of the sample is maintained at a fixed position with respect to the motor. Since the burning surface remains fixed, the direct measurement of the velocity of the propellant feed mechanism for adjusting the position of the propellant sample yields the burning rate. The servomechanism incorporated a 50 mC ^{137}Cs source of gamma rays coupled with a scintillation probe for detecting the position of the burning propellant surface. The output of the probe was converted into a voltage by a ratemeter. It was then amplified and compared to a standard voltage which was proportional to a desired propellant surface position. The resulting difference was amplified for the purpose of driving a 0.6 hp servomotor which positioned the burning surface of the propellant sample. The size of the sample was approximately 2.5 cm square by 10 cm long. The experimental data were obtained with the above servomechanism for two composite propellant formulations. The data were obtained for a range of pressures from 8.8 to 35.5 kg/cm^2, and for burning rates ranging from 0.40 to 0.8 cm/sec. The data correlated well with previously published data. A theoretical analysis of the servomechanism was performed to determine system stability and performance. An optimization analysis of the servomechanism system yielded optimum operating parameters. (auth)

9132 SOME INVESTIGATIONS OF A MULTIPLE ARC PLASMA GENERATOR [Thesis]. Pohlmann, Edward Charles. Stillwater, Okla., Oklahoma State Univ., 1964. 157p.

A multiple arc plasma jet facility was developed and evaluated with respect to the ability of the multiple arc device to increase the enthalpy of jet gas above that possible with the single arc. The efficiency of energy conversion was also evaluated. The multiple arc consists of several electric arc discharges arranged in electrical series, so that the same current passes through each arc. The gas is made to pass through each arc in succession, and when two arcs are used, the first acts as a preheater while the second superheats the gas. Several different electrode configurations of the multiple arc were built and tested. From these preliminary tests two particular designs were selected and tested at currents from 70 to 430 amperes and gas flow rates of 0.0346 to 0.130 pounds of argon per minute. Two modes of operation were observed. At low current levels the arc voltage of the second arc was about four times that of the first arc (Mode I). Mode II is characterized by a nearly equal division of potential between the two arcs, and by a slightly larger potential drop across the first arc. From a composite plot of all data it appears that the transition from Mode I to Mode II occurs at lower values of current for the smaller gas flow rates and at higher values of current for higher flow rates. The range of current over which the transition takes place is from 125 to 250 amperes. The data also show that mode I is more efficient with respect to energy conversion than mode II. The multiple arc is more efficient than the single arc at low power levels. In general the single arc produces the greatest gas enthalpy at intermediate power levels, but the double arc produces higher gas enthalpies at low and high power input levels. For a given current input, however, Mode I operation with the double arc results in the highest gas enthalpy, while the single arc gives the lowest enthalpy. In conclusion, the multiple arc is most useful at low power levels or where the total current available is limited. (Dissertation Abstr.)

Vacuum Engineering

9133 (CONF-650512, pp 7-9) AN UNCONVENTIONAL ULTRAHIGH-VACUUM FACILITY. Wells, E. R. (Oak Ridge National Lab., Tenn.).

To provide pressures of the order of 10^{-10} torr, a vacuum vessel 2 ft in diameter and 8 ft long was fabricated and tested. Pumping was provided by conventional 6-in. NRC diffusion pumps using Dow-Corning 705 oil. The design and operating performance of this system is discussed. (M.O.W.)

9134 (CONF-650512, pp 10-13) VACUUM COMPONENT DEVELOPMENTS. Batzer, Thomas H. (Lawrence Radiation Lab., Univ. of California, Livermore).

Vacuum components which were successfully developed include all-metal gate valves, aluminum foil seals, cryopumps, and clean rough-pumping systems using a water aspirator and zeolites. Development of the design of these components is discussed, together with test results. (auth)

9135 (CONF-650512, pp 14-17) OPTICAL WINDOWS FOR PLASMA RESEARCH. Mullaney, David H. (Princeton Univ., N. J. Plasma Physics Lab.).

Plasma research devices utilize optical windows for many diagnostic measurements. Methods of sealing windows made of glass, sapphire, quartz, and other materials to vacuum chambers are presented. The vacuum properties and reliability of these seals as well as the optical properties are discussed. New methods of sealing quartz and sapphire to metal are presented. (M.O.W.)

GEOLOGY, METEOROLOGY, AND MINERALOGY

General

Refer also to abstract 8817.

9136 (AD-626380) SEMI-ANNUAL TECHNICAL SUMMARY REPORT [ON SEISMIC WAVE DETECTION AND ANALYSIS]. Coker, Frank B. (United ElectroDynamics, Inc., Alexandria, Va. Earth Sciences Div.). Aug. 23, 1962. Contract AF33(657)-7427. 38p. (DATDC-28). CFSTI $2.00 cy, $0.50 mn.

The development of the Data Analysis and Technique Development Center (DATDC) is outlined with emphasis on the development of techniques for the processing of seismic data. The operation of the DATDC is also summarized including preliminary results and the status of analytical systems and the data center. (D.C.W.)

9137 (AD-626382) SEMI-ANNUAL TECHNICAL SUMMARY REPORT [ON ANALYSIS OF SEISMIC DATA]. Van Nostrand, R. (United ElectroDynamics, Inc., Alexandria, Va. Earth Sciences Div.). Oct. 18, 1962. Contract AF33(657)-7427. 18p. (DATDC-34). CFSTI $1.00 cy, $0.50 mn.

Progress in the development of equipment and techniques for the processing of seismic data is summarized. A listing of the digital programs which are in use at the Data Analysis and Technique Development Center is included. (D.C.W.)

9138 (VUF-3019) LABORATORY DESIGN, ANALYSIS, AND FIELD CONTROL OF GROUTING MIXTURES EMPLOYED AT A NUCLEAR TEST IN SALT. Project DRIBBLE—Salmon Event. Polatty, James M.; Bendinelli, Ralph A. (Army Engineer Waterways Experiment Station, Vicksburg, Miss.). May 1965. Contract AT(29-2)-752. 89p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

In the Project DRIBBLE Salmon Event, a 5-kt nuclear device was detonated near the bottom of a 2,720-foot hole drilled vertically into a salt dome in Mississippi. Details are given on work by the U. S. Army Engineer Waterways Experiment Station. Grout mixtures were successfully developed to meet all job requirements. Modifying mixtures to meet depressed temperature requirements did not appreciably alter the desired physical properties of the mixtures. With the exception of one hole, all instrument holes were successfully grouted. Difficulties were experienced in other holes; however, various remedial actions solved these problems. The stemming operation for the device hole was highly successful in all respects. Modifications and the addition of supplemental mixing equipment to the grouting systems considerably improved the quality control of the grout mixture. This improved quality control is believed to have been largely responsible for the successful grouting of the device and instrument holes. (P.C.H.)

9139 RADIOACTIVE ELEMENTS IN THE CONTINENTAL CRUST. Heier, K. S. (Australian National Univ., Canberra). Nature, 208: 479-80(Oct. 30, 1965).

Calculations of the concentrations of the radioactive elements in the earth's crust could indicate that the lower layer has a basaltic composition. But metamorphic processes, including generation of granite magma and the cycling of elements within the crust could also account for the low concentration of radioactive elements in the deep crust. These processes could result in a more mafic average composition of the lower crust as compared with the higher crust. There is also some indication that high-grade metamorphic rocks, especially those of granulite facies, have lower concentrations of thorium and uranium than magmatic rocks of comparable chemical composition, so that the upward concentration of thorium and uranium in the crust could be more marked than that of potassium. It is therefore possible that many volatile and granitophile elements in the crust are overestimated, and that the average continental crust is more mafic than present estimates. (J.F.P.)

Meteorology

See Site Survey and Selection

Refer also to abstract 9165.

Natural Radioactivity and Fallout

See *also* HEALTH AND SAFETY

Refer also to abstract 9099.

9140 CONTAMINATION BY ^{90}Sr AND ^{137}Cs OF TEA LEAVES PICKED IN 1962. Nagasawa, Kakuma; Kametani, Katsuaki (National Inst. of Hygienic Sciences, Tokyo). Eisei Shikensho Hokoku, No. 81, 73-6(1963). (In Japanese).

Strontium-90 and ^{137}Cs were determined in tea leaves to examine radioactive contamination as a result of nuclear weapon tests. Radiochemical procedures are described. The result of determination of these radionuclides in tea leaves, produced in 1962, showed ^{90}Sr content to be 61 to 133 $\mu\mu C/100$ g, and ^{137}Cs, 101 to 393 $\mu\mu C/100$ g. The tea leaves picked in June and July showed the greatest contamination. The tea products had lower contamination than that of original tea leaves. In boiling water extracts of green tea and black tea, the ^{90}Sr was extracted to an extent of about 10% as much as that of the dried tea leaves; however, ^{137}Cs was extracted to an extent of about 50 to 100%. (TCO)

9141 FALLOUT. ACTIVITY LEVELS AND NATURE OF RADIOACTIVE POLLUTION OF THE ATMOSPHERIC DUST AT THE MONCLOA STATION DURING THE PERIOD 1959-1965. Celma Villares, M. (Junta de Energia Nuclear, Madrid). Energia Nucl. (Madrid), 9: 289-301(July-Aug. 1965). (In Spanish).

The problem of radioactive fallout originating from nuclear weapons tests is discussed and its physical and biological aspects are considered. The equipment used for the detection and measurement of the radioactivity is described. A qualitative study was made of the spectra of γ emitters followed by a quantitative study of their spectra. The increasing level of the activity of ^{137}Cs is emphasized. Future levels are predicted and the method used for the determination of the dates of explosions is given. The detection of the Chinese nuclear tests is reported. (J.S.R.)

9142 INTERPRETATION OF GAMMA-RAY SPECTRA OF ENVIRONMENTAL FORAGE SAMPLES. Johnson, James E.; Ward, Gerald M.; Stewart, Harold F. (Colorado State Univ., Fort Collins). Health Phys., 12: 37-42(Jan. 1966).

In studies to determine the fallout deposition of ^{137}Cs, pasture forage samples were collected and analyzed for this radionuclide by γ-ray spectrometery. In determining the concentration of ^{137}Cs there was opportunity to observe the effects of interfering γ-ray emitters due to fallout fission product and activation product activity as well as γ-ray emitters from the natural occurring series. (auth)

9143 ENVIRONMENTAL RADIOACTIVITY IN VENEZUELA FROM JANUARY 1960 TO DECEMBER 1962. Solanas, J.; Darder, A.; Bertou, P. (Instituto Venezolano de Investigaciones Cientificas, Caracas). Health Phys., 12: 43-8(Jan. 1966).

Measurements of gross radioactivity in the air, deposition of ^{90}Sr on the earth's surface and precipitation were

made in Venezuela since January 1960. The values obtained show an increase of fission products activity in the environment as well as an increase of ^{90}Sr deposition. Venezuela has, in both cases, a medium level as compared to other nations of the American continent. It can be observed that there is a linear relation between cumulative ^{90}Sr deposition and cumulative rainfall. Correlations between beta activity in the air and precipitation show a complex inverse relation. Finally, it is pointed out that Venezuela is affected more rapidly by French nuclear explosions due, among other factors, to the fact that these have taken place in the equatorial zone. (auth)

9144 DETECTION OF ^{54}Mn IN FOOD SAMPLES. Neilson, H.; Yakabe, H. M. (Food and Drug Administration, Washington, D. C.). Health Phys., 12: 98-9(Jan. 1966).

During the routine investigation of fallout in food samples using γ spectral analysis, some plant samples were found to display a photopeak at 0.84 Mev that was subsequently identified as ^{54}Mn. Manganese-54 was found in 20 out of 84 plant samples in concentrations on the order of 10^{-13} g per 3 kg sample. It was concluded that contamination of the plant samples came about through biological concentration of undetectable amounts of the nuclide in fallout. The detection in some plant samples but not in others is probably due to the differing requirements of plant types for manganese. (H.G.D.)

9145 ^{90}Sr FALLOUT IN ANTARCTICA. Wilgain, S. (Univ. Libre, Brussels); Picciotto, E.; De Breuck, W. J. Geophys. Res., 70: 6023-32(Dec. 15, 1965).

^{90}Sr and gross β activities were measured on firn sections collected around Base Roi Baudouin, Scott Base, and South Pole Station. The firn layers were dated by stratigraphy and by oxygen isotope variations. The depth distribution of ^{90}Sr and gross β activities revealed three radioactive horizons of potential glaciological application. The deepest horizon occurred at the end of 1953 as a result of the fallout of fission products from the Ivy test series, the second and most important one was formed in early 1955 by the debris of the Castle test series, and a third horizon, defined by a sudden increase in the gross β activity but not in the ^{90}Sr content, was formed at the end of 1962. The rate of ^{90}Sr deposition over Antarctica has been nearly constant since 1956, amounting to 0.2 and 0.1 mC/km^2 yr at Base Roi Baudouin and at the South Pole, respectively. The cumulative ^{90}Sr deposition up to January 1963 in the 70–90°S latitude belt is found to lie between 1 and 3 mC/km^2. (auth)

9146 THE SIZE DISTRIBUTION OF RADIOACTIVE ATMOSPHERIC AEROSOLS. Lockhart, Luther B. Jr.; Patterson, Robert L. Jr.; Saunders, Allen W. Jr. (Naval Research Lab., Washington, D. C.). J. Geophys. Res., 70: 6033-41(Dec. 15, 1965).

Atmospheric air containing natural and fission-product radioactivity was passed successively through a series of filters of increasing retentivity for small particles. The size distribution of the radioactive particles in the atmosphere was deduced from the relative amounts of radioactivity collected on the various filters and a knowledge of the retention characteristics of the filters as a function of particle size. This method demonstrated that the short-lived radon daughter products (^{214}Pb and ^{214}Bi) are associated primarily with particles less than 0.3 μ in diameter, whereas fission products from the stratospheric source of old bomb debris on arrival at ground level are associated with particles averaging between 0.5 and 1.0 μ diameter. Large, apparently random, changes in size distribution often occur from one collection to another. Radiochemical analyses indicate little fractionation of one isotope relative to another except during late October and early November 1964, when the shorter-lived radioisotopes from the Chinese atomic test were found to be associated with the largest particles. (auth)

9147 A SAMPLER FOR RADIOCARBON IN SURFACE AIR. Drobinski, J. C. Jr.; Goldin, A. S.; Shleien, Bernard (Northeastern Radiological Health Lab., Winchester, Mass.). J. Geophys. Res., 70: 6043-6(Dec. 15, 1965).

Compact, automatic equipment for the collection of carbon dioxide from surface air at ambient temperature is described. An oil-free, diaphragm-type compressor pumps air through a silica gel bed, which removes water, vapor, and then through a bed of Linde 5A molecular sieve, which absorbs carbon dioxide quantitatively. The sample is collected over periods of 24 to 28 hours to minimize the influence of transient conditions. In this period, approximately 10 liters of carbon dioxide, equivalent to 5 grams of carbon, are collected. The carbon dioxide is desorbed from the molecular sieve by heating to 500°C and is transferred in vacuo to a purification train. The ^{14}C content of biweekly samples is measured in 7.5-liter gas proportional counters. The specific activity of the carbon increased over the period January 1964 to December 1964, showing that ^{14}C from a stratospheric reservoir was continuously entering the troposphere. However, the values from the first half of 1965 were lower and varied slightly. (auth)

9148 SURVEY OF RADIOACTIVE FALLOUT. ANNUAL REPORT FOR 1964. Man, Sik Kang; Hack, Pil Chung. Kisul Yon'guso Pogo, 3: 57-61(1964). (In Korean).

The activity of fallout for 1964 was measured. Gross beta activity of rain water varied from 540×10^{-4} to 0.02×10^{-4} μC/liter with a mean value of about 3×10^{-4} μC/liter, gross beta activity of fallout dust ranged from 3.447×10^{-4} to 0.15×10^{-4} μC/m^2/day and averaged about 5×10^{-4} μC/m^2/day, total dry deposition was about 1.040mC/km^2/yr, which was about 200mC/km^2/yr higher than last year. The fallout radioactivity showed a maximum in March and April and decreased gradually at the end of the year with an exceptionally sharp peak in October. This high value was probably due to China's nuclear detonation on October 16. The value was 1,500 times as high as that for September and lasted for about a week. The decay curves for the fission products revealed that the n in Way and Wigner's estimate of β is slightly higher than 1.2. (auth)

9149 ANALYSIS OF RADIOACTIVE FALLOUT BY THE METHOD OF γ-RAY SPECTROMETRY. Man, Sik Kang; Hack, Pil Chung; Byung, Ki Sohn. Kisul Yon'guso Pogo, 3: 62-5(1964). (In Korean).

Radioactive fallout was analyzed by the method of gamma spectrometry. A sample was collected on October 20, 1964. From the gamma spectrum it was found that this sample was composed of more than six radioisotopes, such as $^{95}Zr-^{95}Nb$, ^{131}I, $^{140}Ba-^{140}La$, and ^{144}Ce. This was probably caused by the Chinese test of a 20-kt nuclear weapon. (auth)

9150 COMPARISON BETWEEN THE DEGREE OF RADIOCONTAMINATION OF MILK SAMPLES FROM DIFFERENT SOURCES. Porcelli, G.; Marini Bettolo, G. B.; Rossi, C.; D'Agostino, O. (Istituto Superiore di Sanita, Rome). Minerva Nucl., 9: 121-5(May-June 1965). (In Italian).

The values for the total radioactivity due to strontium-89 and 90 and for strontium-90 alone in samples of milk produced in 1962 and 1963 in various places in Italy, with different climates and at different altitudes, as measured after separation on a Dowex 50 × 8 resin column and, in the case of strontium-90 (measured as yttrium-90), after having obtained an equilibrium between strontium-90 and yttrium-90 and precipitation of the latter, are reported. The influence of various seasonal and climatic factors is stressed, and the coefficient of correlation between radioactive fallout and rainfall in the same month and the significance of its difference from zero are calculated for the areas considered. Similar calculations are made for the correlation between the strontium radioactivity in the milk and the fallout. It was found that the above variables are correlated for the areas considered, with the exception of some months with an exceptionally high rainfall. (tr-auth)

9151 THE NATURAL RADIOACTIVITY OF SOME ITALIAN MINERAL WATERS. Cigna, Arrigo A.; Talenti, Mario (CNEN, Rome. Univ., Rome). Minerva Nucl., 9: 248-50(July-Aug. 1965). (In Italian).

A method used for the determination of the ^{226}Ra, ^{222}Rn,

and ^{228}Th content of mineral waters is described. This method is based on the use of scintillation chambers in which the radioactive gases are circulated by means of suitable devices. The results concerning some Italian mineral waters are reported, and some considerations regarding MPC (maximum permissible concentration) were made. (auth)

9152 AN UNUSUALLY RADIOACTIVE FOSSIL FISH FROM THURSO, SCOTLAND. Diggle, W. R.; Saxon, J. (United Kingdom Atomic Energy Authority, Thurso, Scotland). Nature, 208: 400(Oct. 23, 1965).

Energies of γ-emitters were measured on a plate of Homosteus found near Thurso, Scotland. Using a γ-spectrometer the radioactivity was found to be due to the decay chain of ^{238}U with some contribution from the ^{232}Th chain. Distribution of activity, determined autoradiographically, was concentrated into a few small areas. Similar examinations were made on small specimens of Dipterus valenciennisi and Thursius pholidotus. Although these specimens were of similar age, no unusual radioactivity was shown. It is concluded that excessive radioactivity is found only in those fossil fishes having heavy dermal armor. (H.G.D.)

9153 EVALUATION OF ION EXCHANGE CARTRIDGES FOR FIELD SAMPLING OF ^{131}I IN MILK. Johnson, R. H.; Reavey, T. C. (Northeastern Radiological Health Lab., Winchester, Mass.). Nature, 208: 750-2(Nov. 20, 1965).

The field trial of a technique for concentrating and separating ^{131}I from other radionuclides in milk is reported. A small cartridge containing anion exchange resin was used to determine the ^{131}I content of milk in the vicinity of Burlington, Vermont. Results were compared with those obtained by γ spectrometry. The ion exchange cartridge was determined to be an effective means for field sampling of ^{131}I in milk. (H.G.D.)

9154 QUANTITATIVE AND QUALITATIVE DETERMINATION OF NATURAL ALPHA-ACTIVE AEROSOLS BY MEANS OF NUCLEAR EMULSION. Rutkowska, Krystyna. Prace Centr. Inst. Ochrony Pracy, 15: 181-95(1965). (In Polish).

A method for measuring the concentration of natural alpha-active aerosols in air by means of an impactor and nuclear emulsion, assuming that a radioactive equilibrium between radon and its daughters exists in the air is discussed. A method of separating, in the emulsion, traces of alpha particles derived from the decay of ^{212}Po and ^{214}Po by calibrating the nuclear emulsion is also discussed. The results of a series of measurements were interpreted by two different methods in order to verify whether the simplified method is admissible for interpreting microscopic measurements of the lengths of tracks of the alpha particles. (auth)

9155 STUDY OF RADIOACTIVITY IN THE MEXICAN REPUBLIC. PROGRAM OF RADIOLOGIC PROTECTION. Halvas, Jorge (Comision Nacional de Energia Nuclear, Mexico). Salud Publica Mex., 5: 903-10(Nov.-Dec. 1963). (In Spanish).

The results of measurements of atmospheric radioactivity for 1962 performed by a chain of 11 stations distributed throughout Mexico are reported. Maximal, minimal, and average values of total β activity are given in pC/m^3 for each station and each month of the year. A meteorological analysis of the data obtained is included. A study of radioactivity in food and water sources was also conducted, and ^{90}Sr values in milk are given for the principal towns in Mexico. A system for measuring atmospheric radioactivity permitted a correlation of the values obtained with the movements of air masses into the country from other latitudes. There was a marked increase in atmospheric radioactivity during the fall and winter months, and a decrease during the hot months and rainy season. The increase during winter months was due to the ingress of air masses from northern latitudes where the nuclear explosions had taken place, as well as the more frequent occurrence of inversion phenomena during the same months, which accounted for a greater concentration of radioactivity in the thin surface atmospheric layer. Results obtained for ^{90}Sr in milk were lower when compared with countries to the north but similar to those obtained in Hawaii (situated at ~ the same latitude) for the same period. Values for radioactivity in food and water also were lower than in northern countries. (TCO)

9156 DEUTERIUM AND ^{18}O IN PRECIPITATION AND OTHER NATURAL WATERS: SOME THEORETICAL CONSIDERATIONS. Eriksson, Erik (International Meteorological Inst., Stockholm). Tellus, 27: 498-512 (Nov. 1965).

An attempt was made to express the isotope concentration in precipitation as a function of the atmospheric process that transport water vapor. It was found that the fractionation that takes place is considerably less when the atmospheric transport is due to eddy motion than when transport is simply advective. In the latter case fractionation follows the Rayleigh condensation formula. In the case of eddy transport fractionation may under special circumstances follow the same formula although with a factor $(\sqrt{\alpha} - 1)$ instead of $(\alpha - 1)$. More complicated transport patterns in the atmosphere also exist. For the vertically integrated transport it was difficult to derive explicit relations over ocean areas because of the exchange between air and water. Over continents, however, the relation can be formulated more explicitly under certain conditions. Available data showed a general relation between ^{18}O and precipitable water, which indicated that eddy transport is of major importance for distributing water vapor in the atmosphere. For isotope concentrations in surface waters, exchange of water between air and liquid water was important and could not be neglected in cases where data were applied to specific hydrologic problems. (auth)

9157 RADIOACTIVE DECAY OF ^{87}Rb TO ^{87}Sr IN GEOLOGICAL SCIENCE EXCLUSIVE OF AGE DATING. Hurley, P. M.; Fairbairn, H. W.; Pinson, W. H. Jr. (Massachusetts Inst. of Tech., Cambridge); Faure, G. pp 175-8 of Primera Conferencia Interamericana de Radioquimica. Washington, D. C., Union Panamericana, 1965.

The $^{87}Sr/^{86}Sr$ ratios in meteorites, chondritic meteorites, continental volcanic rocks, oceanic volcanic rocks, and continental crustal materials are discussed. The data show that most continental crustal rocks originated from a source region slightly richer in radiogenic ^{87}Sr than the mantle region of oceanic basalt, but not nearly as rich in ^{87}Sr as the average continental crust itself. New granitic rocks were found not to be the results of simple fusion of older crustal material but to be dominantly of material that has not had a long history of Rb/Sr enrichment greater than basalt. (J.S.R.)

Techniques and Equipment

Refer also to abstracts 8815 and 8833.

9158 THE AGE AND INITIAL $^{87}Sr/^{86}Sr$ OF THE HEEMSKIRK GRANITE, WESTERN TASMANIA. Brooks, C.; Compston, W. (Australian National Univ., Canberra). J. Geophys. Res., 70: 6249-62(Dec. 15, 1965).

The Heemskirk granite is divisible into three types, red, white A, and white B, on the basis of field, petrographic, and chemical properties. Rb–Sr analyses of whole-rock samples show that a major difference in initial $^{87}Sr/^{86}Sr$ exists between the red and the white types, that an additional small difference exists between the white A and white B, and that the initial $^{87}Sr/^{86}Sr$ of the red granite is probably nonuniform, with a range from 0.705 to 0.720. The initial $^{87}Sr/^{86}Sr$ of the white A granite is 0.734 ± 0.002, which means that it is several times more enriched relative to average basalt Sr than any granite previously described. The ages of the red and white A granites are indistinguishable at 354 My, but the white B granite could be several million years older. Much xenolithic material in the white granite indicates contamination by crustal ma-

terial during emplacement, and the granite is regarded as a high-level, possibly cupola-type body. (auth)

9159 NUCLEAR PRECESSION WELL LOGGING APPARATUS. Baker, Paul E.; Jones, Stanley B.; Seevers, Delmar O. (to California Research Corp.). U. S. Patent 3,213,354. Oct. 19, 1965. Filed Feb. 17, 1953.

A method and apparatus are provided for differentiating substances by their nuclear magnetic resonance properties that is particularly applicable to logging apparatus for locating hydrogeneous fluids and distinguishing between water and oil in the formation around a bore hole. The apparatus consists of a source of power connected to a polarizing coil, a pickup coil within the polarizing coil, a ferromagnetic core within the polarizing and pickup coil, and a magnetometer that is magnetically isolated from the two coils within the well. An amplifier is connected to the magnetometer, and degaussing coil means around the core are connected to receive current from the amplifier. The amplifier has a gain adjustable to a value such that it is adapted to provide current from the magnetometer to the degaussing coils equal to the current required to remove the distorting effect of the core of the earth's magnetic field. A detector is connected to the pickup coil. (B.L.M.)

9160 APPARATUSES AND METHODS RELATING TO PRODUCTION OF NEUTRON RADIATION. Frey, Hugh B., Jr. (to Schlumberger Well Surveying Corp.). U. S. Patent 3,215,836. Nov. 2, 1965. Filed Oct. 23, 1956.

A radiation source, particularly a neutron source, is provided in which a number of distinct nuclear reactions may be simultaneously or selectively produced. The source is especially adaptable to nuclear well logging. An evacuated envelope contains a source of charged particles. Targets that contain a substance adapted to enter into nuclear reaction with the particles are placed within the envelope at several locations spaced from the source of charged particles. Charged particles from the source are accelerated to a sufficient velocity towards each target, either simultaneously or in the desired sequence. To obtain a number of distinct nuclear reactions, the target materials and/or the respective particle velocities may be different for each target. (B.L.M.)

9161 DEVICE FOR CALIBRATING RADIOACTIVE WELL LOGGING APPARATUS. Hall, Hugh E. Jr. (to Texaco Inc.). U. S. Patent 3,215,837. Nov. 2, 1965. Filed June 15, 1959.

A device for calibrating well logging apparatus that is sensitive to the hydrogen and chlorine content of an earth formation consists of a tubular member having an internal bore suited to receive a logging instrument for calibration and formed of a hydrogenous material such as neoprene to simulate the hydrogen containing earth formation. A predetermined quantity of a chlorine containing material is embedded substantially uniformly in the hydrogenous material around the tubular member at a location between the center and one end of the member to simulate a salt water containing earth formation. The tubular structure is mounted at its midpoint to a portable supporting structure by means of trunnion bearings in such a manner to provide inversion of the member by rotation about the axis of the trunnion bearings in order that a logging instrument may be lowered into either end of the member. The calibration method is described in detail. (B.L.M.)

9162 RADIOACTIVITY WELL LOGGING FOR DETECTING HYDROGEN AND CHLORINE. Hall, Hugh E. Jr. (to Texaco Inc.). U. S. Patent 3,219,820. Nov. 23, 1965. Filed June 15, 1959.

An apparatus for conducting radioactive well logging to indicate the presence of hydrogen chlorine includes an elongated instrument housing formed of ferrous metal and adapted to be passed through a borehole traversing a number of earth formations. The housing contains a source of fast neutrons, a first detector unit indicative of the presence of hydrogen in the formation and substantially insensitive to the presence of chlorine, and a second detector unit arranged to provide a quantitative signal indicative of both the hydrogen and chlorine content of the formation. The signals from the two detectors are plotted in correlation with the position of the logging instrument in the bore hole in such a manner that differences between the two signals provide a quantitative measure of the chlorine content of the formation and corresponding variations in the two signals provide a quantitative indication of the hydrogen content in the formation. (B.L.M.)

9163 RADIOACTIVITY WELL LOGGING FOR DETECTING HYDROGEN AND CHLORINE. McKay, Alexander S.; Hall, Hugh E. Jr. (to Texaco Inc.). U. S. Patent 3,219,821. Nov. 23, 1965. Filed June 15, 1959.

An apparatus for simultaneously determining the hydrogen and chlorine contents of earth formations transversed by a borehole is provided. The elongated housing is formed of ferrous metal and contains a neutron source. A first radiation detection unit is spaced at a predetermined distance from the source along the longitudinal axis of the instrument, and the unit comprises a gamma radiation detector having its active volume substantially surrounded by a thin layer of Cd. A second detection unit comprises a thermal neutron detector and is spaced at a predetermined distance from the source. Means are provided for maintaining the position of the logging instrument in relatively fixed relation to the sides of the borehole during the logging runs. (B.L.M.)

Thorium and Uranium Minerals

Refer also to abstract 10352.

9164 (RME–4530(Rev.)) EXAMINATION OF SELECTED AREAS IN PERU. Gabelman, John W. (Division of Raw Materials (AEC), Washington, D. C. Junta de Control de Energia Atomica, Lima (Peru)). July 1962. 30p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

In brief reconnaissance of parts of southern Peru anomalous radioactivity was noted in the altered red beds of the Ccollpaccasa area, which contains strong folds and faults parallel to and on the north side of the Cordillera Vilcanota. Deposits of principally uranium minerals may occur in the Puntarayoc area marginal to the strongly altered Chancara pipe. They may be richer and more widespread than the known Ni–Co–Cu deposits from which extraction of the small amount of contained uranium seems unwarranted. Also favorable in this area is the low-temperature environment in which uranium commonly occurs. In the lower Vilcabamba valley altered rock is associated with the Chaullay-Cuquipata fault zone. Although only small amounts of anomalous radioactivity have been noted to date, the surface rocks are strongly leached, and the area is otherwise favorable for uranium in veins. In the Vilcanota fault zone several alteration pipes in fluvial sediments with local carbon concentrations are weakly anomalous. Moreover, the alteration belts enclosing the Vilcanota and Laguna de Langui faults registered a background of twice that outside the belts. Since low-temperature uranium tends to be associated with argillization, bleaching, and pyritization, economic uranium deposits may be found in the favorable low-temperature portion of the Vilcanota belt from Urcos to Ollantaytambo. (P.C.H.)

HEALTH AND SAFETY

See also BIOLOGY AND MEDICINE — Radiation Hazards and Protection
GEOLOGY, METEOROLOGY, AND MINERALOGY — Natural Radioactivity and Fallout

Refer also to abstracts 8506, 8743, 8817, 8890, 8979, 9040, 9151, 9263, 9269, 9279, 9283, and 10439.

9165 (BNWL-36, pp 1.1-84) ATMOSPHERIC PHYSICS. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Eight papers are included. Topics discussed are: diffusion and transport model for continuous release in stable atmosphere; dispersion measurements from continuous elevated point source in unstable atmosphere; atmospheric turbulence; area dosage relations downwind of point source; precipitation scavenging; sampler for recording concentration of airborne zinc sulfide on real time scale; fluorescein-zinc sulfide dual atmospheric tracer technique; micrometeorological instrumentation. (P.C.H.)

9166 (BNWL-36, pp 2.1-58) RADIOLOGICAL PHYSICS. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Research progress in radiological physics is reported on: radioactivity measured in Alaskan natives, 1962-1964; seasonal variations of ^{137}Cs in Alaskan Eskimos; uranalysis for ^{137}Cs; ^{22}Na and ^{55}Fe in people and food; radioactivity in an individual Eskimo; simplified whole body counting; ^{137}Cs in Trappist monks; humans exposed to uranium mine atmospheres; standardization of whole body counters; plutonium whole body counting; counting plutonium in animals and in excreta; low energy fast neutron spectroscopy; the secular change of Pu-Be neutron sources; fast neutron medical research facility; instrumentation for local dose measurement; a He ion separator for the Positive Ion accelerator; pulse reader for ion chambers; fast-pulse averaging; an alpha- and beta-ray calorimeter; calorimetric determination of the mean beta energy and half-life of ^{147}Pm; a pulsed x-ray machine; and stopping power ratios for radiation nonequilibrium. References of 36 papers published during the contract period are included. (H.G.D.)

9167 (BNWL-36, pp 5.1-102) INSTRUMENTATION. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Research is reported on radiological measurement methods for: Pu air monitoring; detection of low energy beta particles; and β-γ hand and shoe counting under various conditions. Advances in instrumentation development were made on: an α-β-γ counter for detecting hand and shoe contamination; compact solid state high voltage supplies; an integrator for a portable neutron dose rate meter; a neutron soil moisture monitor; automatic regulation of inhaled aerosols; telemetry for animal physiology and radionuclide uptake measurements; a wound probe for detecting plutonium; animal scanning counters; biological spectrometers and analyzers; peak pulse measuring devices for use with ion chamber dosimeters; a gamma spectrometer for use in whole-body counting; signaling radiation dosimeters; a wind component analyzer; and an automatic data collection system for meteorological tower investigations. References are included for 28 papers published during the contract period. (H.G.D.)

9168 (BNWL-SA-429) RECENT HANFORD DIFFUSION RESULTS SIGNIFICANT FOR ESTIMATING POLLUTION POTENTIAL. Fuquay, J. J.; Elderkin, C. E. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Nov. 23, 1965. Contract AT(45-1)-1830. 21p. (CONF-660401-1). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

For presentation at American Meteorological Society, American Geophysical Union, Annual Joint Meeting, Washington, D. C.

Experimental programs designed to collect data on dispersion of ground sources for several miles are discussed. The data obtained from both continuous ground and elevated sources have been organized most conveniently as a function of travel time for providing estimates of exposures from potentially hazardous releases at Hanford. Measured lateral turbulence parameters, and stability measurements indicating the degree of vertical turbulence, are used to stratify the plume width and peak exposure estimates. (P.C.H.)

9169 (CONF-727) 10TH ANNUAL BIO-ASSAY AND ANALYTICAL CHEMISTRY MEETING, OCTOBER 8-9, 1964. (National Lead Co. of Ohio, Cincinnati). Contract AT(30-1)-1156. 225p. Dep. mn; CFSTI $2.50 cy, $1.25 mn.

Twenty papers were presented on procedures and problems associated with the collection, interpretation, and application of health protection data. Separate abstracts were prepared for 13. The remainder appear in NSA as: 18: 43322 and 43370 and 19: 32, 8724, 24844, 42432, and 46187. (H.G.D.)

For abstracts of individual papers see: 8506, 8539-8543, 8722, 8740, 8741, and 8821-8824.

9170 (CONF-765) RADIOACTIVE FALLOUT FROM NUCLEAR WEAPONS TESTS. Proceedings of the Second Conference, Germantown, Maryland, November 3-6, 1964. AEC Symposium Series No. 5. Klement, Alfred W. Jr. (ed.) (Division of Biology and Medicine (AEC), Washington, D. C.). Nov. 1965. 965p. Dep. mn; CFSTI $6.50 cy, $3.75 mn.

Fifty-seven articles are included on: physical, chemical, and radiological characteristics of atmospheric radioactivity and fallout; long-term particle behavior; local atmospheric transport; global atmospheric transport; and distribution and cycling of radionuclides. (P.C.H.)

9171 (CONF-650616-27) ^{55}Fe IN HUMANS AND THEIR FOODS. Palmer, H. E.; Beasley, T. M. (Health and Safety Lab., New York Operations Office (AEC), N. Y.). [1965]. Contract AT(11-1)-34. 9p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

From Health Physics Society Annual Meeting, Los Angeles.

Iron-55 was recently found in the blood of Alaskan caribou and since then measurements were made on the content of this isotope in Eskimos and in residents of Richland, Washington, and in the food of both. Measurable quantities of ^{55}Fe are found. The amount in Eskimos and caribou at Anaktuvuk, Alaska, was about 8 times that in residents and cattle near Richland, Washington. Meat and grains were found to be the foods that contribute most to the human ^{55}Fe body burdens. (P.C.H.)

9172 (CONF-650616-28) EVALUATION OF THE HAZARD FROM RADIOACTIVE GAS AND OZONE AT LINEAR ELECTRON ACCELERATORS. George, Andreas C.; Breslin, Alfred J.; Haskins, James W. Jr.; Ryan, Robert M. (Health and Safety Lab., New York Operations Office (AEC), N. Y.). Oct. 1965. 54p. (CONF-651109-18). Dep. mn; CFSTI $3.00 cy, $0.50 mn.

From Health Physics Society Annual Meeting, Los Angeles and 1st Symposium on Accelerator Radiation Dosimetry and Experience, Upton, N. Y.

The occurrence of the radioactive gases ^{15}O and ^{13}N and of ozone and the exposures to personnel from these gases

at two linear electron accelerators were evaluated. The principal features of the two accelerators along with the experimental variables—type of target, beam intensity, duration of operation, etc.—that relate to the production and distribution of these gases are described. Extensive measurements of the gases during a variety of typical experimental conditions show that the respective maximum permissible concentration for the radioactive gases and for ozone are frequently exceeded by substantial factors in the shielded accelerator and target rooms when the electron beam is on. Residual gases at the termination of experiments constitute exposures to personnel who enter these areas. However, cumulative radiation exposures resulting from the radioactive gases were not significant. The principal methods that are used to control the gases and to minimize exposures are evaluated with respect to the two accelerators that were studied and to other accelerators at which the gases may occur. (P.C.H.)

9173 (HASL–166) ^{14}C MEASUREMENTS IN THE ATMOSPHERE. (Health and Safety Lab., New York Operations Office (AEC), N. Y.). Jan. 1, 1966. 73p. Dep. mn. CFSTI $2.50 cy, $0.75 mn.

Data on atmospheric ^{14}C measurements are tabulated. Most of the data pertain to aircraft observations but a few deal with balloon-borne sampling and ground level collections. The Defense Atomic Support Agency Star Dust Program and some earlier data from a United Kingdom program are included. (P.C.H.)

9174 (NP–15763) DATA FROM RADIATION PROTECTION PROGRAMS. Volume 3, Number 10. (Department of National Health and Welfare, Ottawa (Ontario). Radiation Protection Div.). Oct. 1965. 38p. Dep. mn.

Three articles giving fallout data for Jan. to June and Sept. 1965 are included. Separate abstracts were prepared for each. (P.C.H.)

For abstracts of individual papers see: 9175–9177.

9175 (NP–15763, pp 3-12) ^{137}Cs LEVELS IN THE CANADIAN NORTH, JANUARY–JUNE 1965. Mohindra, V. K.; Gordon, J. H. (Department of National Health and Welfare, Ottawa (Ontario). Radiation Protection Div.).

The results of ^{137}Cs measurements in meat and human urine samples collected during the first half of 1965 are reported. The meat samples were taken from reindeer, caribou, and moose. Seasonal and geographic variations are discussed. (P.C.H.)

9176 (NP–15763, pp 13-25) CANADIAN FALLOUT DATA FOR SEPTEMBER 1965. Samuels, E. R.; Mohindra, V. K. (Department of National Health and Welfare, Ottawa (Ontario). Radiation Protection Div.).

The results of measurements on ^{137}Cs and ^{90}Sr in milk and precipitation, ^{89}Sr in milk, and total beta activity in air during Sept. 1965 are reported. The data are compared with that for 1964. Generally a decrease in radioactivity levels for all parts of the fallout program was found for 1965. (P.C.H.)

9177 (NP–15763, pp 26-38) REACTOR ENVIRONMENT MONITORING FOR SEPTEMBER 1965. Samuels, E. R.; Mohindra, V. K. (Department of National Health and Welfare, Ottawa (Ontario). Radiation Protection Div.).

Samples of surface water from selected areas above and below Canadian reactors were monitored during Sept. 1965. Milk and air samples were also monitored. Data are given for total alpha and beta activity, ^{89}Sr, ^{90}Sr, ^{137}Cs. (P.C.H.)

9178 (NP–15770) SUPPLEMENTAL ANALYSIS—CIVIL DEFENSE RESCUE. Phase 1b Analytical Report. Crain, John L.; Meister, Robert K.; Thomas, Lacy G.; Spurlock, Eugene M. (Stanford Research Inst., Menlo Park, Calif.). Aug. 1965. Contract OCD-PS-64-55. 68p.

The results of extended studies on the trapping function, the probable number of persons to be trapped in debris; the relationship between thermal effects and rescue feasibility; the organizational requirements and other criteria on which a rescue system must be based; and techniques for detection of existence of life within debris are reported. The four research areas are treated separately, but integrated within a common introduction and summary. (auth)

9179 (NRL–6341) ATMOSPHERIC RADIOACTIVITY IN ANTARCTICA, 1956–1963. Lockhart, L. B. Jr.; Patterson, R. L. Jr.; Saunders, A. W. Jr. (Naval Research Lab., Washington, D. C.). Aug. 11, 1965. Contract AT(49-7)-2435. 18p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Continuous measurements of the radioactive aerosol content of the surface air in Antarctica have been made since 1956 first at Little America and later at the Amundsen-Scott South Pole Station. Both the radioactivity due to bomb-produced fission products and to the naturally occurring radionuclides of the radon and thoron series were measured in daily collections; composite samples covering three-month periods were subjected to radiochemical analysis for such long-lived radionuclides as ^{90}Sr, ^{137}Cs, ^{144}Ce, ^{147}Pm, and ^{210}Pb. The observed natural radioactivity was lower in Antarctica than at any other geographical location, as might be expected from the absence of any quantity of exposed land surface in the vicinity. The fission-product concentrations, however, were equal to or greater than those observed in the southernmost parts of South America. Well-defined seasonal variations in airborne radioactivity were noted, with maxima in the summer. (auth)

9180 (ORNL–TM–1309) FIRE PROTECTION SYSTEM IN CELL A, BLDG. 3026D, TEST AND OPERATION. Walls, A. A. (Oak Ridge National Lab., Tenn.). Oct. 18, 1965. Contract W-7405-eng-26. 19p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

A CO_2 fire protection system was installed in Cell A of the Dismantling Cells, Building 3026D, in preparation for the disassembly of irradiated Sodium Reactor Experiment (SRE) fuel elements. The tests and modifications of the system which were necessary before it was acceptable for operation are described. The SRE elements contained NaK, and several steps of the disassembly were performed under flammable oil. One major fire did occur but the protection system performed without fault and quickly extinguished the fire. The system has been relatively free of maintenance and appears practical from an operating standpoint. Its use continues in work involving flammables. (auth)

9181 (SC–TM–65-397) APPLICATION OF THE LOG-NORMAL FUNCTION TO THE MASS DENSITY AND NUMBER DENSITY DISTRIBUTION OF SPHERICAL PARTICLES. Warnke, D. F. (Sandia Corp., Albuquerque, N. Mex.). Dec. 1965. Contract AT(29-1)-789. 27p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

The log-normal distribution is described in terms of mass and number distributions of particles. All of the associated mathematical relations are formulated. An example illustrates the use of log-normal density and distribution function including curves and tables of these functions. An Appendix describes a short FORTRAN program for calculating the probability density functions. (auth)

9182 (SZS–8(1965)) DIE BERUFLICHE STRAHLENBELASTUNG 1964 IN DER DEUTSCHEN DEMOKRATISCHEN REPUBLIK. (Professional Radiation Protection in the German Democratic Republic, 1964). Brasack, G.; Kraus, W. (Staatliche Zentrale fuer Strahlenschutz, Berlin (East Germany)). Aug. 1965. 20p. Dep. mn.

Results of the personnel dosimetry of 16,762 persons in 1964 are reported. A survey on monthly over-exposures (more than 0.4 rad) as well as on the distribution of annual exposures is given. The results of personnel dosimetry in 1963 and 1964 are compared. Suggestions for improvements in radiation protection are given. The total situation of occupational exposures in the GDR is estimated as satisfactory. (auth)

9183 (UCRL–7997) MOVEMENT AND DISPERSION OF ION SPECIES THROUGH POROUS MEDIA. Knox,

Joseph B. (Lawrence Radiation Lab., Univ. of California, Livermore). Sept. 3, 1964. Contract W-7405-eng-48. 50p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

A numerical simulation model was developed for the transport and dispersion of ion species in porous media. Effluent histories calculated by means of this model for both homogeneous and heterogeneous one-dimensional columns were compared with observed effluent histories obtained from laboratory column experiments. The results indicate that the transport and dispersion of ion species in a porous medium can be adequately treated as an initial value problem if the following information is known: the statically determined distribution coefficient for trace concentrations of ion species in the medium under study; and the medium's porosity, its dispersion constant, and the velocity of the fluid through it. Practical formulas were derived from equilibration theory for peak solute concentration and time of arrival as a function of the down-column coordinate. These formulas are illustrated by means of several applications to the evaluation of potential ground water contamination. In the examples presented, ion exchange retardation keeps the ^{90}Sr pulse in the immediate vicinity of its initial location for a long period of time. (auth)

9184 (USNRDL-TR-933) RADIONUCLIDE FRACTIONATION IN AIR-BURST DEBRIS. Freiling, E. C.; Kay, M. A. (Naval Radiological Defense Lab., San Francisco, Calif.). Sept. 20, 1965. Contract AT(49-7)-1963. 13p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Radiochemical data from fractionated samples from 15 airbursts provided a source of equivalent-fission values for 24 radionuclides. The airbursts ranged in yield by a factor of over 300. The equivalent-fission values were converted to ratios based on ^{95}Zr and these ratios were correlated logarithmically. The correlation slopes were found to be relatively insensitive to yield and their values permitted the placement of the radionuclides on a scale of volatility. Several groups of radionuclides which did not fractionate from each other were found. The nuclides ^{137}Cs and ^{140}Ba had essentially the same slopes for air bursts as for high-yield surface bursts, but ^{99}Mo and ^{239}Np behaved more volatilely in the air bursts. Finally, the volatility inferred from fractionation behavior correlated well with that based on thermodynamic calculations. (auth)

9185 (Y-KB-64) DIAGNOSTIC AIR MONITORING AND RELATED SAMPLING EQUIPMENT FOR RADIOACTIVE AND TOXIC PARTICULATES. Sanders, Merwyn (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). Sept. 15, 1965. Contract W-7405-eng-26. 15p. (CONF-650963-1). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From Health Physics Society, Fall Symposium, Gaithersburg, Md.

Sampling techniques and equipment that are used in uranium processing areas and in sampling other air pollutants are described. In the general air monitoring program in the Y-12 Plant, an IBM aperture card is equipped with a filter medium to collect air samples. Advantages of the system and other potential applications are listed. (P.C.H.)

9186 AN UNFAVORABLE ENCAPSULATION EXPERIENCE WITH SCREWED-TIP RADIUM SHEATH NEEDLES. Clay, Cassius M.; Brown, Mark; Engler, Harold S. (Medical Coll. of Georgia, Augusta). Amer. J. Roentgenol., Radium Therapy Nucl. Med., 96: 56-8(Jan. 1966).

Three potentially hazardous experiences with 45 screwed-tip, gold alloy radium sheath needles over a 7 year period are reported. The advisability of permanent double encapsulation is emphasized, and a simple method of converting single encapsulated sheath needles is described. (auth)

9187 A MASS POSTAL SURVEY OF DENTAL X-RAY UNITS IN NEW SOUTH WALES. Foskett, W. E. (Dept. of Public Health of New South Wales, Sydney). Austral. Dent. J., 10: 162-8(Apr. 1965).

A survey of dental x-ray machines was made following passage of an amendment to the New South Wales Radioactive Substances Act which requires all medical practitioners, dentists, and veterinary surgeons using irradiating apparatus either to possess a licence or to work under the direction and supervision of a licensee. Prior to the issue of a licence it is required that the x-ray equipment to be used should conform with certain radiation safety standards. In the system used, a film assembly was mailed to the dentist together with an explanatory booklet and simple instructions for use and exposure. The package was subsequently returned to the Department of Public Health, where it was processed and assessed. From the information so obtained, it was possible to determine the characteristics of the x-ray machine. Follow-up action is being taken to ensure that all machines found to be defective will be corrected. Thus, this investigation showed that prior to this mass survey a large proportion of the dental x-ray machines in use in New South Wales did not comply with currently accepted radiological safety standards, in that they did not have sufficient inherent filtration or irradiated a larger area of the patient than was necessary. A few had housing defects resulting in radiation leakage. (BBB)

9188 RADIATION SURVEY OF RADAR EQUIPMENT AND ACCIDENT PREVENTION AND SAFETY MEASURES. Naba, Katsumi. Boei Eisei, 12: 121-31(1965). (In Japanese).

High-power radar equipment is capable of emitting two potentially hazardous radiations in the electromagnetic spectrum. One is the microwave output, and the other is x radiation. A survey of microwave and x-ray emissions was made on AN/FPS-6 and AN/FPS-20 site aircraft radars and ECM radars. It was found that if one radar was positioned lower than the other in a radar site, a negative tilt of AN/FPS-6 caused the beam to be directed downward toward the area where personnel were working. As expected, the most dangerous area of microwave exposure was in front of the aircraft radar antenna. The Thyratron 1257 apparatus emitted x radiation at dose rates exceeding 100 mR/hr at a distance of 50 cm from the tube. Dose distribution in the x-ray beam was made by means of x-ray film using emulsion density-dose relations. Microwave shielding effects of several materials were studied by microwave power density measurements experimentally, and the lighting limit of a neon lamp for the pulsed microwave S-band and X-band was also studied. (BBB)

9189 RADIATION PROTECTION. Schmidt, Arthur (Dept. of Health of Ontario, Toronto). Can. Med. Ass. J., 93: 1134(Nov. 20, 1965).

Several problems in estimating radiation exposure in occupational situations are briefly discussed, particularly as concerns the failure of personnel to wear their film badges at all times and the assessment of exposure from hematologic tests. Determination of small radiation doses by regular medical examinations is far less accurate and reliable than by the use of personal dosimeters. However, workers often are exposed when not wearing their badges. Leaving the coat or jacket, with the film in it, inadvertently near the x-ray machine is the standard explanation received during inquiries into unusually high film exposures. There is reason to suspect that radiographers anticipating excessive exposures may at times not use their film monitors in order to avoid embarrassing questions by their supervisors or government agencies. Presence or absence of blackening appears to be conclusive proof of the exposure history of a film, but not necessarily of the alleged wearer. It is, therefore, necessary that further improvement of biological methods is made so that clinical demonstration of small doses becomes possible. Medical surveillance of workers with potential exposure to nuclear radiations is essential, and the Canadian Atomic Energy Control Regulations disqualifies any person whose health is such that in the opinion of the health authority, employment as an atomic energy worker would be undesirable. The opinion of a health authority upon which the livelihood

of workmen and their families may depend should be based on properly established and documented facts. The purpose of medical examinations of appropriate frequency is not the measurement of radiation doses but the demonstration of the worker's suitable state of health. (BBB)

9190 RADIATION PROTECTION. Williams, N. (Dept. of Public Health, Regina, Saskatchewan, Can.). Can. Med. Ass. J., 93: 1134-5(Nov. 20, 1965).

Problems in monitoring occupational radiation exposure in terms of Canadian regulations are briefly discussed, and the use of periodic medical examinations to detect exposure is considered. Certification requirements for industrial radiographers are reviewed. (H.G.D.)

9191 THE STORAGE AND HANDLING OF HYDROGEN WITH SAFETY. Stoll, A. P. (British Oxygen Co. Ltd., London). Chem. Eng. (London), No. 185, CE11-16(Jan.-Feb. 1965).

The flammability of hydrogen is discussed, together with methods of preventing and dealing with hydrogen fires. Techniques and equipment for handling liquid hydrogen in the laboratory are also considered. (D.C.W.)

9192 THE SAFE HANDLING OF LIQUID HYDROGEN. Scharle, W. J. (Air Products and Chemicals Inc., Allentown, Pa.). Chem. Eng. (London), No. 185, CE16-24(Jan.-Feb. 1965).

The properties of hydrogen and general procedures for the safe handling of hydrogen are reviewed. Quantity-distance relations for liquid-hydrogen storage tanks for production facilities and missile test stands are included. Methods for disposing of liquid hydrogen are also outlined, and the hazards of oxidants in liquid hydrogen are discussed. Equipment and methods for the transportation of liquid hydrogen are also considered. (D.C.W.)

9193 THE GERMAN ATOMIC ENERGY LAW IN USE. Fischerhof, H. (Univ., Frankfurt am Main). Energiewirtsch. Tagesfrag., 14: 412-14(Sept. 1964). (In German).

A brief review is given of the most important aspects of the German atomic energy law and the problems in its application. The approval of nuclear installations, fuel element transportation, legal questions of nuclear ships, modifications to the radiation protection regulations, and security precautions regulations are considered. An indication is also given of the problems still unresolved. (J.S.R.)

9194 LEGAL QUESTIONS IN THE TRANSPORT OF UNIRRADIATED AND IRRADIATED FUEL ELEMENTS. Warrikoff, A. Energiewirtsch. Tagesfrag., 14: 415-17 (Sept. 1964). (In German).

The legal questions involved in the transportation of irradiated and non-irradiated fuel elements are discussed with respect to the liability standards, the uniformity of insurance conditions in international transportation, public interest in damage cases, and special problems in the transport of fuel elements. (J.S.R.)

9195 FUEL ELEMENT TRANSPORTATION IN COMPARATIVE LEGAL VIEWPOINT. Pelzer, Norbert. (Univ., Goettingen, Ger.). Energiewirtsch. Tagesfrag., 14: 418-23(Sept. 1964). (In German).

The legal requirements for the transportation of nuclear fuels in various countries are compared with respect to the approval and monitoring of transportation processes and liabilities for damages. (J.S.R.)

9196 THE CALIBRATION OF LIQUID SAMPLES OF LOW INTENSITY. Das, H. A.; van Raaphorst, J. G.; Umans, H. J. K. M. (Reactor Centrum Nederland, Petten, Netherlands). EuroNuclear, 2: 544-7(Nov. 1965).

A method is described for the calibration of gamma-emitting radionuclides in solution using a well-type crystal. The crystal is calibrated by measuring the gamma spectra for a series of radionuclides. Calibrated 500 λ glass tubes are used as sample holders. The method is based on a simple mathematical description of the intensity of the observed gamma peaks. Data are presented for ^{51}Cr, ^{198}Au, ^{137}Cs, ^{54}Mn, ^{52}V, ^{28}Al, ^{49}Ca, ^{144}Pr, ^{24}Na, ^{65}Ni, ^{22}Na, ^{46}Sc, ^{60}Co, ^{56}Mn, ^{38}Cl, and ^{59}Fe. (M.C.G.)

9197 CERTAIN ISSUES OF INDUSTRIAL HYGIENE IN RADIOACTIVE ORE MINING. Malygin, A. A. (Ordzhonikidze Inst. of Geology, Moscow). Gig. Sanit., No. 10, 51-8(Oct. 1965). (In Russian).

A method of controlling gas emanation from the scrubbing blocks is described. The method consists in creating a low air pressure level in the lump medium and a high pressure level in the free spaces by means of ordinary ventilation devices. On the basis of experimental data on the study of 6 schemes of airing of the block, where ore was stored, a special draining scheme (scheme "d") is recommended for field use. A method of calculating the rate of air current in the lump material that makes it possible to correlate the extent of airing with the dimensions of the scrubbing blocks is presented. The method was tested experimentally under industrial conditions and gave sufficiently precise results for its field use. (auth)

9198 A TECHNIQUE OF ASSESSING THORIUM BODY BURDENS UTILIZING IN VIVO GAMMA SPECTROMETRY. Scott, L. M. Health Phys., 12: 101-3(Jan. 1966). (Y-KB-58).

A technique was developed to screen for thorium lung burdens using ^{212}Pb and ^{228}Ac which are daughters of thorium. Due to properties of thorium and its daughters, it is primarily qualitative. However, it can be made quantitative by establishing or estimating thorium to daughter ratios. The method consists of comparing the ratio of gamma count rate in adjacent energy region for suspected exposed persons against those from unexposed persons. (auth)

9199 EMPIRICAL RADIOTOXICITY HAZARDS AND GENERAL LICENSING EXEMPTIONS. Donth, Hans H. (Bundesministerium fuer Wissenschaftliche Forschung, Bad Godesberg, Ger.); Maushart, Rupprecht. Health Phys., 12: 106-8(Jan. 1966).

Measurements of accidental intake of radioactive substances at the Karlsruhe Nuclear Research Center are reported. Regarding non-volatile nuclides, incorporations observed did not exceed 10^{-5}. Data are tabulated for intake of ^{137}Cs, $^{95}Nb-^{95}Zr$, ^{106}Ru, ^{90}Sr, ^{210}Po, ^{192}Ir, ^{131}I, ^{38}Cl, ^{3}H, and fission products. (H.G.D.)

9200 TRANSPORT OF IRRADIATED FUEL FROM NUCLEAR POWER STATIONS IN THE UNITED KINGDOM. Ainsworth, S. I. J. Brit. Nucl. Energy Soc., 4: 299-306 (Oct. 1965).

The problem of transporting fuel from magnox power stations within the United Kingdom is discussed. The controlling features of the methods of transport are summarized, and the equipment developed to achieve the necessary performance is described. (D.C.W.)

9201 THE CONCEPT OF CONTROLLED AREA: A CRITICAL APPRAISAL OF THE EURATOM REGULATIONS FOR PROTECTION AGAINST IONIZING RADIATIONS. Strambi, E. (CNEN, Rome. Univ., Rome); Tagliati, S. Minerva Nucl., 9: 126-31(May-June 1965). (In Italian).

A number of modifications are proposed regarding the Euratom Regulations concerning the definition of controlled area and the classification of nuclear workers. A number of practical examples regarding an Italian nuclear research center are presented. (C.H.)

9202 BIOLOGICAL INVESTIGATIONS CONCERNING THE ENVIRONMENTAL RADIOACTIVITY. I. PLAN OF STUDY. Rossi, Luciana Cigna; Cigna, Arrigo A. (CNEN, Rome). Minerva Nucl., 9: 138-48(May-June 1965). (In Italian).

The criteria from which living beings can be classified from the standpoint of sensitivity to the environmental radioactivity are described. Such classifications can be made by placing the species in order of relative abundance, or according to their concentration factors for the substances considered (fissile, fission products, activation products). Measurement of radioactive contamination in

the first type of classification can supply information of immediate interest as regards medical protection, whereas its measurement in the second type of classification can reveal very low levels of environmental contamination. From the data available in specialized journals, the above considerations are applied both to the aquatic and to the terrestrial environment. (auth)

9203 DECONTAMINATION OF CERTAIN FABRICS USED FOR MANUFACTURE OF SAFETY CLOTHING, CONTAMINATED BY RADIOACTIVE ISOTOPES ^{32}P, ^{35}S, ^{131}I, AND ^{226}Ra. Smal, Zbigniew; Chmielewska, Jadwiga. Prace Centr. Inst. Ochrony Pracy, 15: 197-205(1965). (In Polish).

The decontamination of fabrics used for safety clothing (impregnated and nonimpregnated), contaminated by ^{32}P, ^{35}S, ^{131}I, and ^{226}Ra was studied. Detergents, citric acid of various concentrations, as well as tap water were used as decontaminants. It was determined that the efficiency of decontamination depended on the type of isotope, the finish of the textile surface (impregnated and nonimpregnated), and on both the kind and concentration of the decontaminant used. (auth)

9204 TECHNIQUES OF RADIOACTIVITY MEASUREMENTS IN FOODSTUFFS. Wozniak, Jan (Warsaw Medical Academy). Rocz. Panstv. Zakladu Hig., 16: 467-75 (1965). (In Polish).

A quick method is described of checking the radioactivity level in foodstuff samples on the basis of determination of general β-activity and so-called special oxalate β activity, deriving the sum of mostly injurious elements (Sr, Y, Ba, La, Ra, Ce, and the others). Procedures are described. The equipment consists of GM counter (type BAT-25), impulse amplifier PWD-1, high voltage stabilized power supply unit PZS-5, and impulse counter PEL15. Method of computation of results and their statistical appraisal is presented for routine work for monitoring of radioactivity in foodstuffs. (auth)

9205 TECHNICAL ASSESSMENT OF THE PROBLEMS OF RADIOLOGICAL PROTECTION. Telich, Jose (Asociacion de Fisicos de Hospitales, A. C., Mexico). Salud Publica Mex., 5: 911-14(Nov.-Dec. 1963). (In Spanish).

Problems of radioprotection in medical, industrial, and scientific research situations are discussed. Safety features in the construction of x-ray and sealed radioisotope sources are described and measures to be employed in use of such equipment are outlined, with attention to an assessment of the possible hazards by monitoring procedures while the equipment is in use. Attention is also directed to features which may contribute to excessive patient exposure during the diagnostic use of the apparatus, particularly fluoroscopic devices. Specific problems encountered in the use of Ra, Rn, and some of the newer radionuclides, such as ^{198}Au, are mentioned, and precautions for their use proposed. Possible hazards in industrial radiographic procedures and in mining and metallurgical fields are examined. Precautions which should be used by research scientists employing radioisotopes are outlined, with a discussion of prevention and handling of accidental spillage of radioactive materials. Steps which should be taken in accidents which may involve excessive exposure of personnel are also considered. (BBB)

9206 OBSERVATIONS ON CONTAMINATION OF FOOD BY RADIOACTIVE SUBSTANCES AND IONIZING RADIATIONS FROM THE STANDPOINT OF THE HYGIENIST. Loscher, J. (Univ., Greifswald, Ger.). Z. Ges. Hyg., 10: 1-15(Jan. 1964). (In German).

The significance to human health of the radioactive contamination of the biosphere is discussed, particularly with reference to fallout radionuclides in food. The natural α-activity levels in various food products are tabulated, and estimates are given of their contribution to human radiation exposure. The doses provided by natural internal radioactivity from ^{14}C, ^{40}K, and Ra are discussed in relation to the contribution made by internal deposits of ^{89}Sr, ^{90}Sr, ^{106}Ru, ^{131}I, ^{137}Cs, ^{140}Ba, and ^{144}Ce. Human tissue (mainly bone) assays of these radionuclides are presented and discussed, with a comparison of levels reported for various parts of the world. Importance of various routes of incorporation of radionuclides (from inhalation, drinking water, food) by humans is considered. Radiation-induced effects in somatic and germinal cells to be expected after various levels of contamination of humans are estimated. Use of ionizing radiation to pasteurize or sterilize food is reviewed, with a discussion on changes in nutritional qualities of irradiated foods. (BBB)

9207 RADIOACTIVITY MEASUREMENTS AT SEA LEVEL ON A TRIP FROM THE KATTEGAT TO THE DAVIS STRAIT. Marquardt, W. (Amt fuer Meteorologie, Halle, Ger.). Z. Meteorol., 18: 157-60(1965). (In German).

A series of measurements of atmospheric radioactivity made in the latter half of 1963 by the fishing research vessel Ernst Haeckel in going from Denmark to Labrador is reported. Filtered air samples were collected and measured every 8 hr. The results showed that atmospheric radioactivity over the North Atlantic was as little as 1% of the activity measured over land stations. The activity varied as follows, as measured at various sites (pC/m^3): Bad Elster 470 (July 1963), 319 (Oct. 1963); Wahnsdorf 319, 284; Arkona 73, 99; Kattegat —, 124; Skagerrak —, 37; North Atlantic 5, —; Davis Strait, Labrador 11, —. The high levels at the land-based stations are of geologic origin (U, Th, Ra, Rn). The nearness of the ship to land masses was clearly reflected in the activity measurements, and these were further affected by wind direction. Thus measurements in Davis Strait during a sea wind were $\sim 1/10$ those made during wind from the land mass. Atmospheric radioactivity was lower over the ocean during a fog than on a clear day. The contribution of artificial (fallout) radioactivity to these measurements was assessed. In Oct. 1963, this was estimated to be about 1.5 pC/m^3. (BBB)

9208 MEDICOLEGAL ASPECTS OF THE USE OF NUCLEAR ENERGY. De Vincentiis, Giovanni; Zangani, Pietro; Gualdi, Giorgio (Univ. Sassari, Italy). Zacchia, 26: 39-104(Jan.-June 1963). (In Italian).

A review is given of statutes and regulations in force in Italy regarding medical-legal aspects of injuries from ionizing radiations. Reference is made to compulsory insurance required by industry for occupationally exposed workers and by physicians for injuries caused by medical uses of x rays and radioisotopes. The law (No. 1860) regarding these regulations instituted on December 31, 1962, is explained. Protective practices that are required by users of radiation devices are outlined. The problem of legal responsibility is discussed from the point of view of determining whether a case of radiation exposure was accidental or not, assessing the dose received by the claimant, diagnosis of radioinduced occupational diseases, and determination of degree of disability from radiation injury. The influence of antecedent and incidental factors on results of radiation accidents is considered. The deficiencies of compulsory insurance regulations for physicians, other than radiologists, are pointed out, particularly the lack of remuneration for total temporary disability from radiation injury. Medical treatment provisions of radiation-disabled persons are also inadequate, except in severe cases of permanent injury. Legal problems arising from increasingly widespread uses of nuclear energy are dealt with, and possible solutions for some of these problems proposed. (BBB)

9209 BROOKHAVEN EXPERIENCE WITH HANDLING AND SHIPPING OF, AND CASK DESIGN FOR, REACTOR SPENT-FUEL ELEMENTS. Dugan, Francis A. (Brookhaven National Lab., Upton, N. Y.). New York, American Society of Mechanical Engineers, 1965, Preprint No. 65-WA/NE-7, 7p., $1.50. (CONF-651110-22; BNL-9259). ORINS.

From American Society of Mechanical Engineers, Annual Winter Meeting, Chicago.

General problems in the shipping of spent fuel elements

are discussed. Solutions to specific problems at Brookhaven are discussed in relation to the general problem. Canal storage facilities, methods of shipment, AEC and ICC regulatory requirements, and optimized design of the shipping container are described. Specific solutions used by BNL over a six-year period are outlined. (auth)

9210 PERSONNEL EXPOSURE CONTROL DURING THE REPAIR OF MASSIVE POWER REACTOR COMPONENTS. **Nelson, W. F. (Consolidated Edison Co. of New York, Inc., New York). 11p. (CONF-650616-14). ORINS.**

From Health Physics Society Annual Meeting, Los Angeles.

A study of radiation exposure to personnel during the repair of four nuclear heat exchangers and two primary coolant pumps at the Indian Point Station was made. A summary of the exposures during the six week period is given. The experience at seven of the domestic power reactors indicates that the highest rate of radiation exposure occurs during those periods when major maintenance is performed on the primary system components. An examination of the total exposures in 13 week periods to all personnel at these reactors was used to obtain the given range of exposures. (J.F.P.)

9211 RADIOLOGICAL PROTECTION IN RADIOCHEMICAL LABORATORIES. **Vizeu, Dirceu M. (Instituto de Energia Atomica, Sao Paulo, Brazil). pp 155-60 of Primera Conferencia Interamericana de Radioquimica. Washington, D. C.; Union Panamericana, 1965. (In Portuguese).**

The radiochemical division of the Institute of Atomic Energy of Brazil is divided into wings; a hot wing and a cold wing. The routine radiological protection adopted for each of these wings is described. (J.S.R.)

9212 TRANSFER DEVICE FOR IRRADIATED MATERIALS. **Evans, J. H. (Oak Ridge National Lab., Tenn.). pp 188-9 of Proceedings of the 13th Conference on Remote Systems Technology, 1965. Hinsdale, Ill., American Nuclear Society, 1965.**

A device was designed to transfer alpha-, gamma-, and neutron-emitting material between a shielded enclosure and a cask without breaking containment. The bagging technique commonly used in glove-box technology is used in conjunction with a handling tool and a shielded cask. (M.C.G.)

9213 AUTOMATIC LIFTING MECHANISM. **Youngquist, C. H.; Lindberg, J. F. (Argonne National Lab., Ill.). pp 190-1 of Proceedings of the 13th Conference on Remote Systems Technology, 1965. Hinsdale, Ill., American Nuclear Society, 1965.**

An overhead bridge crane and a lifting mechanism to remove radioactive sources from storage tubes are described. The lifting mechanism has a pointed end on a vertical shaft. This end is guided through a hole in a circular latch block permanently fixed to the load to be lifted. As the shaft is lowered, hardened pawls in the latch block are swung outward. They engage a shoulder at the lower end of the lifting shaft. The hook can then be lifted with the load attached. (M.C.G.)

9214 COOLING GRAPPLE FOR HANDLING RADIOACTIVE SOURCES. **Ferguson, K. R.; Simon, J. P.; White, J. R. (Argonne National Lab., Ill.). pp 192-4 of Proceedings of the 13th Conference on Remote Systems Technology, 1965. Hinsdale, Ill., American Nuclear Society, 1965.**

A grapple was developed for handling EBR-II reactor core subassemblies in the air cell of the Fuel Cycle Facility. It could be adapted to handle any radioactive source with a knob-like end fitting. The transfer grapple consists of a 4-ft-long rigid tube containing a mechanical locking device in its lower end. A spring-loaded device locks the grapple to the subassembly. A subassembly is cooled by drawing cell air through it and the grapple suction pumps located in the sub cell area. (M.C.G.)

9215 RADIOACTIVE PROCESS FOR DETECTION OF SURFACE CONTAMINATION. **Anderson, John Lynde (to Cleanometer Corp.). U. S. Patent 3,215,839. Nov. 2, 1965. Filed Dec. 27, 1960.**

A rapid and quantitative method is described for the detection of non-volatile organic contamination either on metal surfaces or within the spaces confined by metal surfaces. The method consists of dissolving a non-volatile radioactive compound, n-triacontane-^{14}C, in a volatile solvent, trichloroethylene; contacting the surfaces with the resulting solution; evaporating the trichloroethylene; measuring the radioactivity along the treated surfaces; and comparing the results with radioactivity measurements obtained in a control run effected by applying the method to an uncontaminated like surface. (B.L.M.)

INSTRUMENTATION

General

Refer also to abstracts 8747, 8816, 9368, 9605, and 9613.

9216 (CONF-650512, pp 44-7) AN INDUCTIVE ENERGY STORAGE SYSTEM USING IGNITRON SWITCHING. Simon, Ellis D.; Bronner, George (Princeton Univ., N. J. Plasma Physics Lab.).

An inductive energy storage switching system was developed, making possible the economical utilization of stored inductive energy from kilojoules to more than gigajoules. The ignition switching system utilizes a bridge circuit and a capacitor to invert from the unidirectional current of an inductive source to an alternating voltage of triangular waveform. The alternating voltage is rectified. By the use of two capacitors, whose maximum stored energy is very small compared with the total energy to be transferred, the stored energy may be transferred to the load in discrete parcels. The separation of storage and load circuits allows the transfer of all stored energy to the load, with the exception of the usual resistive energy loss imparted by the circuit elements, a quantity which can be kept small. Therefore, the energy efficiency is higher than heretofore attained by inductive energy storage systems. (M.O.W.)

9217 (CONF-650512, pp 68-71) TESTS OF OIL-PAPER ENERGY STORAGE CAPACITORS AT HIGH VOLTAGE STRESS TO DETERMINE PROBABLE LIFETIMES. McFarlane, H. Bruce (Lawrence Radiation Lab., Univ. of California, Livermore).

A capacitor type that was rated a few years ago at 14 μF, 20 kv was re-evaluated. (Several manufacturers have made improvements so that it will now hold 40 kv.) Samples of six brands were tested by subjecting them to ringing discharge tests at about 70 kc. The statistical analysis indicates that two brands are superior to the others. (auth)

9218 (CONF-650512, pp 72-6) ELECTRICAL CHARACTERISTICS OF COAXIAL CABLES. Boicourt, G. P. (Los Alamos Scientific Lab., Univ. of California, N. Mex.).

A pulsed ringing method was used to measure the inductance and resistance of several special coaxial cables used as transmission lines in banks for controlled thermonuclear research. The cables are described, the method of measurement is outlined, and the properties of the cables are given. (auth)

9219 (CONF-650512, 77-90) DEVELOPMENT OF FAST 100-kv, 1-MA, SOLID DIELECTRIC SWITCHES AND ASSOCIATED TRIGGERING STUDIES. James, T. E.; Harries, K.; Medford, R. D. (Culham Lab., United Kingdom Atomic Energy Authority, Abingdon (England)).

The switch, which was developed initially as a single start switch for a 100-kv theta-pinch gun, is described. The edges of the switch plates are moulded in epoxy resin or silicone rubber to prevent surface flashover along the polythene insulation. The main current arc strikes on the walls of a 1 in. diameter hole or recess in the electrodes and is maintained there by its own magnetic pressure, thus preventing erosion of the electrode surface adjacent to the main insulation. Various tests and operating experiences with the switch are discussed. (M.O.W.)

9220 (ECOM-2639) FURTHER STUDIES ON HYDROGEN AND DEUTERIUM CLEANUP. Schneider, Sol; Yeamans, Norman L. (Army Electronics Command, Fort Monmouth, N. J.). Dec. 1965. 23p. CFSTI $1.00 cy, $0.50 mn.

In view of the increasing use of deuterium as a fill gas, a limited experiment to study the transient cleanup phenomena in deuterium was conducted. It was determined that hydrogen and deuterium transient cleanup obeys the same fundamental relation with respect to discharge parameters. In both cases the percentage cleanup under dynamic operating conditions is directly proportional to the square root of the power dissipated in the tube. There were no apparent differences in the solubility factor, S_D, of the equation. The prime difference in the behavior of both gases was determined to be the difference in diffusion rates. The experimental techniques, fundamental relations, theoretical considerations, influence of the physical state of the nickel, and long-term effects are discussed. (P.C.H.)

9221 (INR-642/XYIII/PP) OPREDELENIE OTNOSITELNOI I ABSOLYUTNOI CHUVSTVITELNOSTI SISTEMY MONOKHROMATOR-FOTOUMNOZHITEL. (Relative and Absolute Calibrations of the Arrangement Monochromator UM-2-Photomultiplier) Novikovski, I.; Sukever, Sh. (Institute of Nuclear Research, Warsaw (Poland)). 1965. 15p. Dep.

The results of calibrations of the arrangement Monochromator, type UM-2—photomultiplier type FEU—33 within the range of wavelength λ = 4000 to 6400 Å are presented. The calibrations include: determination of dependences of the relative current values i_a of the photomultiplier on the light wavelength λ, as also values of the current i_{abs}, corresponding to the quantities N of $h\nu$ quanta emitted by the known surface in unit of time. The relations $i_a = \zeta(\lambda)$ obtained by two methods, dynamical – using an SFR-2M revolving-mirror photocamera and static, are compared. (auth)

9222 (LA-3318) ELECTRICAL CHARACTERISTICS OF COAXIAL CABLE. Boicourt, Grenfell P. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). Apr. 15, 1965. Contract W-7405-eng-36. 6p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

A pulsed ringing method was used to measure the inductance and resistance of several special coaxial cables used at the Los Alamos Scientific Laboratory as transmission lines in banks for controlled thermonuclear research. The cables are described, the method of measurement is outlined, and the properties of the cables are given. (auth)

9223 (LA-DC-7502) NEW SCAN CONVERTER SYSTEM FOR FAST TRANSIENT SIGNALS. Benton, Clarence U. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). [nd]. Contract W-7405-eng-36. 4p. (CONF-660301-1). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

For presentation at IEEE International Convention, New York.

With the development of two new interchangeable high environment fast writing scan converter tubes, a state-of-the-art scan converter system was developed for remote measurements of fast transient signals. Some of the specifications are: 100 G acceleration, 25 G vibration, 14,000 R integrated gamma dose before target erasure, tenth nanosecond rise times, 50 volt sensitivity without amplification, 340 line resolution, 5,000 frame or three day storage, standard telemetry readout bandwidth, 29 lb weight, and 35 watt total power consumption. The fast digital readout system has positive line and frame synch. The package may be rocketborne, mounted in or dropped from a high performance aircraft, or used surface or subsurface in a high radiation environment. (auth)

9224 (RT/EL(65)5) UNA STRUTTURA MODULARE A DIODI E TRANSISTORI PER IL TRATTAMENTO DELLE INFORMAZIONI IN ESPERIENZE DI FISICA NUCLEARE. (A Modular Structure of Diodes and Transistors for the Treatment of Information in Nuclear Physics Experiments). Carlucci, A.; de Agostino, E. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). June 1965. 15p. Dep. mn.

Design of a modular structure at combinational levels is

described. The maximum frequency of operation with a very high fan-in is of the order of some megacycles. (auth)

9225 (RT/FI(65)34) DISTRIBUZIONI CASUALI DI CONTEGGI E CORRELAZIONI INTRODOTTE DAGLI STRUMENTI DI MISURA. (Random Distributions of Counts and Correlations Due to Measuring Devices). Pacilio, N.; Ferrari, T. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Sept. 1965. 16p. Dep. mn.

A theoretical and experimental analysis of random distributions is realized as an approach to the application of stochastic methods to the discrete ensembles of counting problems. A theory of the correlation due to non-ideal measurement devices is presented and some experimental comparisons are given. The method suggests a simple way to measure the instrumentation dead-time. It also allows a correct approach to the short-time-variance method (prompt neutron lifetime measurements in nuclear reactors). (auth)

9226 (SC-TM-65-577) A FAST-PULSE RECORDING AND READOUT DEVICE USING TUNNEL DIODES. Guth, J. R. (Sandia Corp., Albuquerque, N. Mex.). Dec. 1965. Contract AT(29-1)-789. 14p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

An analog memory device that is capable of recording the peak amplitude of a single pulse with a duration of 2 nanoseconds or more is described. The construction and performance of a practical peak-reading voltmeter based on this memory unit is also discussed. (auth)

9227 (SLAC-PUB-150) IMMITTANCES OF REDUCED DEGREE AND NONPOSITIVE REAL IMMITTANCES IN NETWORK SYNTHESIS. Bingham, John A. C. (Stanford Linear Accelerator Center, Stanford Univ., Calif.). Oct. 1965. Contract AT(04-3)-400. 10p. (CONF-651047-1). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From 3rd Annual Allerton Conference on Circuit and System Theory, Chicago.

In previous work by Darlington (Bell Telephone System Monograph B1186, p. 44) on a symmetrical parametric band-pass filter of degree eighteen, a real network with all positive elements which performed exactly as perscribed was found from two nonpositive real immittances. The theoretical resolution of this paradox is discussed. (M.O.W.)

9228 A QUANTUM PARAMAGNETIC AMPLIFIER WITH COUPLED RESONATORS FOR THE 10 cm REGION. Martirosyan, R. M.; Prokhorov, A. M. Cryogenics, 5: 252-5(Oct. 1965).

The construction of a quantum paramagnetic amplifier with two coupled resonators for the 10 cm region is described. A solenoid with superconducting windings is used for the d-c magnet; this reduces considerably the weight of the amplifier and achieves a very stable d-c magnetic field. The characteristics of the amplifier studied experimentally showed that the amplification factor over the band increased 2.5 times compared with a single-resonator amplifier. This agrees well with the amplifier parameters calculated theoretically. (auth)

9229 A NUCLEAR RADIATION SENSITIVE SWITCH. Auerbach, P. B. (American Bosch Arma Corp., Garden City, N. Y.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci., NS-12: 38-42(Dec. 1965).

High intensity pulsed nuclear radiation tends to make back biased semiconductor junctions conduct. The design and development of a circuit which would provide a switch opening in response to nuclear radiation pulses are reported. The design objectives for the radiation sensitive switch are outlined. A prototype switch was designed and constructed. A number of tests were conducted in a high energy linear accelerator (LINAC) to investigate circuit performance under the irradiation. The results of the tests proved that the radiation sensitive switch is feasible and practical. (L.B.S.)

9230 TESTING OF ROCKET ELECTROSTATIC FLUXMETER. Shvarts, Ya. M.; Markchev, N. T.; Petunin, A. N.; Rudakov, V. P.; Skvortsov, V. V. Kosm. Issled., 3: 660-2(July-Aug. 1965). (In Russian).

Laboratory tests of an electrostatic fluxmeter of the rotary type with thin wire meshes and a synchronous detector are reported. The sensor was placed in a chamber under vacuum of $10^{-4}-10^{-5}$ mm Hg and subjected to bombardment of argon ions with energies of 1000 ev or less. Determinations were made of mesh permeability for streams of charged particles and of the effectiveness of the screen plates and synchronous detector as noise suppressors. The coefficient of optical transparency of the screen was 0.87, while the electrical permeability for an ion flux of $10^{-9}-10^{-7}$ amp/cm^2 was $0.82-0.86$. The noise suppressing capabilities of the device are such that a noise current density of 1.1×10^{-7} amp/cm^2 and an electric field intensity of 8 v/cm are needed to make the signal to noise ratio 1. (ATD)

9231 PRODUCTION OF HOMOGENEOUS INTENSE MAGNETIC FIELDS USING SUPERCONDUCTORS. APPLICATION TO NUCLEAR MAGNETIC RESONANCE. Sauzade, M. (CNRS, Orsay, France). Onde Elec., 45: 946-57(July-Aug. 1965). (In French).

Following a discussion of the requirements on the magnetic fields in electron and nuclear resonance studies and of the advantages of superconducting coils for such applications, a solenoid with compensated end effects is described with which a maximum field of 58×10^3 gauss with a homogeneity of 10^{-7} in a 100 mm^3 volume can be obtained. The results obtained in a proton resonance study of ethyl alcohol are summarized. (D.C.W.)

9232 HIGH SPEED MICROWAVE PHASE SHIFTERS USING VARACTOR DIODES. Gardner, Andrew L.; Hawke, Ronald S. (Univ. of California, Livermore). Rev. Sci. Instrum., 37: 19-22(Jan. 1966).

A reflection type microwave phase shifter is described which is similar to the units developed by Hardin, Downey, and Munushian. It employs the voltage-variable capacitance of varactor diodes as the adjustable element. The "pill type" diodes tune their associated circuit through a resonance to produce phase shifts of over 90°. With proper adjustment of the tuning—a simple procedure—the output amplitude is made essentially constant. The use of two series diodes mounted back-to-back permits higher power operation, although the unit is essentially a low power device. (auth)

9233 PEAK SHAPE IMPROVEMENTS BY AVERAGING SPOT-TO-SPOT VARIATIONS IN PARTICLE MULTIPLIER SENSITIVITY. Hebeda, E. H. (Laboratorium voor Isotopen-Geologie, Amsterdam). Rev. Sci. Instrum., 37: 125(Jan. 1966).

Improvements made in the peak shape by applying an a-c voltage on the deflection plates of an electron multiplier detection system are noted. (L.B.S.)

9234 AN IMPROVED OMEGATRON OF THE ALPERT TYPE WITH ELECTRODES FOR WORK WITH NONRESONANT IONS. Gentsch, H. (Technische Hochschule, Hanover). Vakuum-Tech., 14: 150-7(Sept. 1965). (In German).

Some difficulties that occur when the omegatron is in operation are discussed and constructive changes in the design of the electrode system to overcome these difficulties are reported. The effect of the space charge built up by nonresonant ions is eliminated by two additional ion collectors. Thus, besides the measurement of the partial pressure the omegatron may be used for the monitoring of the total pressure in the 10^{-10} to $1 \cdot 10^{-3}$ torr range. The resolving power $m/\Delta m$ is tripled simply by decreasing the hf-voltage without using a stronger magnetic field. The loss of sensitivity is small. The resulting resolving power is sufficient to resolve the doublets H_2^+, D^+ and H_3^+, HD^+ in H_2-D_2 mixtures. A method for the determination of deuterium in hydrogenium is described. An isotope mixture of known composition is analyzed to demonstrate the precision of measurement. (auth)

9235 A RADIATION AND SHOCK RESISTANT MICROPHONE FOR HOT CELLS. Forster, George A.

(Argonne National Lab., Ill.). pp 198-9 of Proceedings of the 13th Conference on Remote Systems Technology, 1965. Hinsdale, Ill., American Nuclear Society, 1965.

A microphone was designed for use in a fuel reprocessing cell where a gamma intensity of 10^5 r/hr is expected and where the cell wiring (MgO insulated cable) is not suitable for low-level audio signals. The complete microphone including preamplifier and cable is expected to withstand 10^{10}r. The microphone survived 10 drops from a 3-ft height onto a concrete floor. (M.C.G.)

9236 CHARGED-PARTICLE SOURCE. Takeda, Yasushi (to Hitachi, Ltd.). Japanese Patent 1964-23453. Oct. 21, 1964. Filed Mar. 18, 1963.

The method proposed provides an electron current having a high parallelism and good pulse shape even when the current output is made a desired value. The method is used in a pulsed charged-particle source, which has a cathode, an electrode for taking out the charged-particle beam, and accelerating electrodes. The voltage of the former electrode, when impressed with control pulses, is made approximately the same as the natural voltage produced by the voltage of the cathode and of the accelerating electrodes. The effective area of the holes for the passage of the charged-particle beam is made variable, thus controlling the charged-particle current output. The holes are located either in or near the accelerating electrodes. (NSA of Japan)

9237 ELECTRON SOURCE IN THE ELECTRON-TUBE SYSTEM. Aihara, Ryuzo (to Sumitomo Electric Ind., Ltd.). Japanese Patent 1964-23454. Oct. 21, 1964. Filed July 1, 1963.

An improvement is made to an electron source for an electron-tube system, which is used in a high-energy particle accelerator, electron microscope, mass analyzer, etc. A type of door is installed between the part where the electron gun with its filament is located and the particle accelerating part. The filament can be replaced while the door is closed, thus maintaining the accelerating part in high vacuum. (NSA of Japan)

9238 ELECTRON GUN. Kaneko, Takeo (to Tokyo Shibaura Electric Co., Ltd.). Japanese Patent 1964-23455. Oct. 21, 1964. Filed Aug. 1, 1963.

The electron gun described consists of an anode, cathode, and grid, a device for impressing a high tension between the anode and cathode, and a phase-shifting device for adjusting the phase of the electric tension applied to the grid. The apparatus permits convenient adjustment of the density and direction of the electrons from the cathode. (NSA of Japan)

9239 ELECTRON GUN. Kaneko, Takeo (to Tokyo Shibaura Electric Co., Ltd.). Japanese Patent 1964-23456. Oct. 21, 1964. Filed Aug. 1, 1963.

In the electron gun proposed, the voltages applied between the anode and cathode and to the control grid can be changed continuously with the same wave shape. The voltage of the control grid is always maintained at the value most suitable for the anode voltage; this is achieved by obtaining both the voltages from the wires wound around the iron core of the same transformer. Thus, the electrons are emitted from the cathode in the same direction. (NSA of Japan)

9240 TEMPERATURE MEASUREMENT OF A FLAME INCLUDING INTRODUCING RADIOACTIVITY INTO A FLAME AND MEASURING THE RADIOACTIVITY THEREOF. Schultz, Warner W. (to General Electric Co.). U. S. Patent 3,215,838. Nov. 2, 1965. Filed June 29, 1962.

A method and apparatus are patented for measuring the temperature within unconfined gases, such as flames, exhaust gas jets, and plasmas. The method consists of introducing radioactivity into the body of unconfined gas where the temperature is to be measured, for example, the core of the flame. The radiation sensed by viewing across the core of the flame and also by viewing across the flame at a point avoiding the core is determined. The radioactivity of the core alone is determined as a function of the two measured radioactivities, and the radioactivity of a given volume of the core is inversely proportional to the temperature of the core. (B.L.M.)

9241 ATMOSPHERIC FALL-OUT COLLECTOR. Blondeau, Emile; Doury, Andre; Francois, Henri (to Commissariat a l'Energie Atomique). U. S. Patent 3,216,246. Nov. 9, 1965. Priority date Feb. 9, 1962, France.

An atmospheric fallout collector comprises a substantially vertical duct having a gaged aperture at its upper end and a funnel communicating with a precipitation-receiving container. A surface coated with an adhesive substance for retaining dry fallout substances is provided between the duct and the funnel. A retractable member is adapted to protect the surface against precipitation and to guide precipitation towards the funnel. The retractable member is controlled by means responsive to a precipitation detector. (B.L.M.)

Radiation Detection

Refer also to abstracts 8805, 8907, 8979, 9185, 9695, and 9893.

9242 (AD-624857) HYDRA PROGRAM: A SHORT-RANGE TELEMETERING ROCKET FOR MEASUREMENT OF UNDERWATER-NUCLEAR-BURST PLUME RADIATION. Final Report. Irre, E. W.; King, K. M.; Walker, B. R. (Zimney Corp., Monrovia, Calif.). Aug. 23, 1965. Contract N228(62479)-59902. 55p. (USNRDL-TR-914). CFSTI $3.00 cy, $0.50 mn.

An instrument system was developed for the measurement of beta and gamma radiation fields in and adjacent to the water column and plumes ejected into the atmosphere by an underwater nuclear explosion. The system consists of a rocket with payload so fired that it traverses the area of interest in a near-vertical trajectory at the proper time. The payload consists of two gamma and one beta radiation transducer, an FM-FM multiplex transmitter, and an associated power supply. The rocket motor is a standard Mk. 10, Mod. 6 HVAR fitted with three different sizes of drag cone to achieve the desired trajectories. A zero length launcher is used. A receiving and recording station for the output of the transmitter was also designed. Nine test flights were made, three of which contained payloads. Sufficient trajectory information was obtained from these flights to establish a reasonably accurate set of drag coefficients for the three different sizes of drag cones. This information allows the calculation of trajectory and range for launch elevation angles other than those used in the test flights. (auth)

9243 (AECL-2505) TIMING CHARACTERISTICS OF LARGE COAXIAL Ge(Li) DETECTORS FOR COINCIDENCE EXPERIMENTS. Graham, R. L.; MacKenzie, I. K.; Ewan, G. T. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). Oct. 1965. 23p. (CRGP-1225; CONF-651001-17). Dep. AECL $1.00.

From IEEE Nuclear Science Symposium, San Francisco.

The results are presented of a study of the variation with position of the charge collection time and its influence on coincidence resolving time. With two Ge(Li) spectrometers both detecting 511-kev events the coincidence resolution curve has a full width at half-maximum of ~15 nsec and approximately exponential tails with half slopes ~5 nsec. An example of a gamma-gamma coincidence spectrum observed in the study of the ^{156}Gd level scheme is described. (auth)

9244 (ANL-7029, pp 4-8) THE 7.7-m BENT CRYSTAL SPECTROMETER. Smither, R. K.; Namenson, A. I. (Argonne National Lab., Ill.).

A combination gamma spectrometer which makes use of a Ge-diode gamma detector in conjunction with the Argonne 7.7-m bent-crystal spectrometer is described. The spectrometer is used to determine the gamma spectra of ^{114}Cd formed by neutron capture in ^{113}Cd. (M.O.W.)

9245 (BNL-9705) A SMALL ANGLE SCATTERING EXPERIMENT. Rabinowitz, G. (Brookhaven National

Lab., Upton, N. Y.). Oct. 1965. Contract AT-30-2-GEN-16. 17p. (CONF-651039-2). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

From Conference on Programming for Flying Spot Devices, Columbia, N. Y.

Efforts toward the use of BNL pattern recognition programs to study $\bar{p}$-p scattering in the angular range of 1 to 20 milliradians are discussed. The programs associated with this experiment divide into two stages; (1) the abstraction of beam track data from the pictures and (2) the analysis of the abstracted tracks. Only the first is discussed. (M.O.W.)

9246 (BNL-9714) CONTROL SYSTEM FOR BROOKHAVEN AUTOMATIC SCANNING PROGRAMS. Weneser, Betty (Brookhaven National Lab., Upton, N. Y.). Oct. 1965. Contract AT-30-2-GEN-16. 24p. (CONF-651044-6). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

From Conference on Programming for Flying Spot Devices, New York.

An operating procedure was developed to facilitate the development of new computer programs toward automatic scanning of digitized bubble chamber photographs. This operating procedure is described. (M.O.W.)

9247 (BNL-9728) PERFORMANCE OF BROOKHAVEN FILTER. Crennell, D. J.; Hough, P. V. C.; Nardi, J. A.; Stonehill, D. L.; Strand, R. C. (Brookhaven National Lab., Upton, N. Y.). [1965]. Contract AT(30-2)-Gen-16. 23p. (CONF-651044-1). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

From Conference on Programming for Flying Spot Devices, New York.

Studies on FILTER performance prior to geometrical reconstruction are summarized, and FILTER results as they are used to obtain geometrical variables are discussed. Bubble density measurements are also discussed. The use of FILTER for Mark II data from the 80-inch chamber is considered. (P.C.H.)

9248 (EUR-2577.i) DESCRIZIONE DI UNA SONDA A SCINTILLAZIONE DI GRANDE SUPERFICIE A DOPPIO RIVELATORE. (Description of a Double-Detector Large-Surface Scintillation Probe). Dominici, G.; D'Adamo, D. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). June 21, 1965. 16p. Dep. mn.

A portable scintillation alpha-beta detector of high sensitivity and counting efficiency for surface contaminations is described. The active detector surface made out of plastic scintillator and ZnS(Ag) has an area of 100 cm^2. (auth)

9249 (LF-28, pp 1-12) A SIMULATED ANNULUS DETECTOR FOR LARGE VOLUME SAMPLES. Boecker, B. B.; Goodrich, R. M. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.).

A gamma detection system for biological samples that will yield good spectral data and be insensitive to changes in sample size was investigated. In this system, the samples are rotated around an axis parallel to the axis of a long, cylindrical NaI detector. Data obtained to date on its response to 1 ml and 1 quart samples demonstrate that this system can be made insensitive to geometry changes of this magnitude while maintaining a usable counting efficiency (3% for Cs-137). Construction details are given. (auth)

9250 (NYO-3510-14) BIOLOGICAL AND CLINICAL DOSIMETRY. Annual Progress Report, July 1, 1964-June 30, 1965. Laughlin, John S. (Sloan-Kettering Inst. for Cancer Research, New York). July 6, 1965. Contract AT(30-1)-3510. 80p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

During the period of this report local dose microcalorimeter previously described was employed to examine the depth-dose distribution produced in carbon by high energy electrons. Cavity ionization measurements were made in the same geometry and corrected to dose in rads with and without the polarization correction. It is significant that at large depths where the electron energy was low the absolute values of dose obtained by these two methods agree. At lesser depths the polarization correction was required to bring the two methods into approximate agreement. The significance of some remaining discrepancy at higher energies is being further investigated. An intercomparison of the dose produced by high energy electron beams as measured at different institutions was instituted. Both the lithium fluoride thermoluminescent dosimeter and the Fricke ferrous sulphate dosimeter have been under extensive development with respect to different methods of packaging for mailing, procedures for optimum reproducibility, etc. A significant difference between the dose in rads as measured by lithium fluoride luminescence and by the Fricke ferrous sulphate dosimeter between cobalt-60 gamma rays and high energy electrons was discovered. The significance of this unexpected dependence of lithium fluoride thermoluminescence on radiation quality is being investigated. Measurements of the dose produced by the electrons from a high intensity source (600 kev field emission generator) have been initiated. Doses of the order of megarads delivered in 30 nanoseconds have been measured with cellophane dye and thermoluminescent methods. A calorimeter is being designed to carry out these measurements on a more absolute basis. The investigation of solid state detectors uncovered a temperature dependence. A further effect involving a change in current output from the detectors under prolonged irradiation was found to be associated with the effects of ionized air on the surface of the devices. Irradiation in vacuum eliminated this. (28 references.) (C.H.)

9251 (SLAC-52) A SUBNANOSECOND COINCIDENCE CIRCUIT. Barna, Arpad (Stanford Linear Accelerator Center, Stanford Univ., Calif.). Nov. 1965. Contract AT(04-3)-515. 63p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

A coincidence circuit with a resolving time of 0.3 nsec is described. An evaluation of the performance of the circuit is summarized in which a pulsed light source and two photomultipliers were used. An analysis of the performance of the circuit is also included. (D.C.W.)

9252 (SLAC-PUB-121) PHYSICAL PROPERTIES OF FILAMENT WOUND GLASS EPOXY STRUCTURES AS APPLIED TO POSSIBLE USE IN LIQUID HYDROGEN BUBBLE CHAMBERS. Brechna, H.; Haldemann, W. (Stanford Linear Accelerator Center, Stanford Univ., Calif.). July 1965. Contract AT(04-3)-400. 47p. (CONF-650802-14). Dep. mn; CFSTI $2.00 cy, $0.50 mn.

From Cryogenic Engineering Conference, Houston, Tex.

Physical property tests on glass filament-epoxy-film-composites which were recently proposed as a feasible material for a liquid hydrogen bubble chamber body placed in a very high pulsed magnetic field are described. Static and dynamic loadings, dielectric strength, thermal conductivity, and permeability to liquids at various temperatures such as 300, 77.8, 28 and 4.2°K tests are performed on straight rectangular pieces of different composition at various thicknesses up to one inch and a series of cylinders up to 0.0362 inch wall thickness, up to failure stresses. It is found that the physical properties of some of these composites are entirely suitable for liquid hydrogen bubble chamber use, namely at temperatures of 28°K and an internal pressure of 150 psi. Fatigue tests up to 10^7 cycles of operation up to 9000 psi flexural and 300 psi shear stress showed that the filament structure had not lost its original properties. (auth)

9253 (UCRL-12197) THERMAL FOGGING OF PERSONNEL MONITORING FILM. Kathren, R. L. (Lawrence Radiation Lab., Univ. of California, Livermore). Nov. 12, 1964. Contract W-7405-eng-48. 11p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

Thermal fogging did not occur in personnel monitoring films held at temperatures below 50°C for up to 216 hours. Films maintained at temperatures above 50°C were fogged nonuniformly, with peak fogging occurring at relative humidities of 40-60%. The hypothesis stating that com-

peting reactions from radiolytic products of water cause the humidity dependence of response to gamma radiation was disproved. (auth)

9254 (UCRL-14270) MEASUREMENT OF GAMMA RAY INDUCED SECONDARY ELECTRON CURRENT FROM VARIOUS ELEMENTS. Ebert, Paul J.; Lauzon, Alfred F. (Lawrence Radiation Lab., Univ. of California, Livermore). Sept. 15, 1965. Contract W-7405-eng-48. 24p. (CONF-651001-16). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

From IEEE Nuclear Science Symposium, San Francisco.

Knowledge of the angular distribution and absolute efficiency for gamma ray induced secondary electron currents is necessary in the development of fast radiation detectors, in dosimetry and in transient radiation effects studies. The angular distribution of the emergent forward electron current and the absolute quantum efficiency for 1.25-Mev gamma ray induced secondary electron current was measured for elements having atomic numbers 6, 13, 29, 48, and 82. To ensure electron equilibrium, targets of thickness about equal to the extrapolated range of a 1.25 Mev photoelectron were used. The non-equilibrium thickness of one-tenth the extrapolated range was also used. A significant difference between the total target current and the total foward current was observed. This difference increased with atomic number and target thickness, as would be expected from results of electron backscattering experiments. Forward currents, calculated as a function of atomic number and target thickness, using Mar's universal electron transmission formula and taking into account both Compton and photoelectric effects, agree well with experimental results. (auth)

9255 (UCRL-16307) THE IMPACT OF SEMICONDUCTOR DETECTORS ON GAMMA-RAY AND ELECTRON SPECTROSCOPY. Hollander, Jack M. (Lawrence Radiation Lab., Univ. of California, Berkeley). Aug. 1, 1965. Contract W-7405-eng-48. 131p. (CONF-650832-1). Dep. mn; CFSTI $4.00 cy, $1.00 mn.

From International Meeting on Nuclear Instrumentation, Herceg-Novi, Yugoslavia.

A review of the semiconductor impact on gamma spectroscopy is presented. In particular, the operating characteristics of Ge(Li) detectors are discussed along with its many uses. Examples of data taken with semiconductor detectors are presented for the following: decay scheme studies, measurement of pair production cross section near threshold, heavy-ion reactions, low temperature nuclear orientation, g-factors of nuclear excited states, observation of the effect of chemical state on the lifetime of a low-energy isomer, neutron activation analysis, and electron-gamma spectroscopy. (M.O.W.)

9256 NUCLEAR RADIATION DETECTORS WITH SEMICONDUCTOR DEVICES. [PART] I. Poenaru, Dorin; Vilcov, N. (Inst. of Atomic Physics, Bucharest). Acad. Repub. Pop. Rom. Stud. Cercet. Fiz., 17: 203-42(1965). (In Rumanian).

Although it has been known for some time that solids present advantages for counting x or γ radiation, such as low ionization energy and higher stopping power, they were employed only in the form of photographic emulsions or scintillators. Since 1949 attempts were made to employ high-purity Ge as a detector of charged particles; following these studies, many semiconductor detectors were developed, in particular for recording heavy charged particles, such as protons, deuterons, α particles, fission fragments, etc. These instruments have excellent resolving power, they withstand fluxes up to 10^{14} protons/cm^2 and 10^{11} α particles/cm^2 and may be used in the presence of a relatively high γ background. With special circuitry, high energy electrons and γ rays may also be recorded. A 4-Mev α particle is able to transfer about 2 kev maximum energy. This collision process also allows a shift of electrons from the valency band to the conductance band, forming electron-vacancy pairs. The path of the low-energy electrons formed by collision is only about 0.1 μ; therefore, the trajectory of heavy primary particles is marked by a thin cylindrical plasma of vacancies and electrons. The time of stoppage is estimated at 2.8×10^{-12} sec for electrons and 2.6×10^{-11} sec for α particles. Equations were derived for following the movement of charge carriers, and their collection in actual devices, taking into account the problem presented by the noise. (Review article, 27 references) (TTT)

9257 A SINGLE-CHANNEL TUNNEL DIODE AMPLITUDE ANALYZER. Scintei, N. (Inst. of Atomic Physics, Bucharest). Acad. Repub. Pop. Rom. Stud. Cercet. Fiz., 17: 323-7(1965). (In Rumanian).

Single-channel amplitude analyzers operate reliably and have a simple design. An attempt was made to improve their operation by including into the circuit a low-signal tunnel diode with a dead time of only about 0.1 μsec. By means of a pulse transformer an anticoincidence circuit was created, increasing the reliability of the system. The pulses delivered by the photomultiplier pass through 2 repeaters to the diode and transistors which form the expander circuit. By means of a 100-ohm helipotentiometer the diode was negatively polarized at 0 to -2 v. The analyzer's output signal was 2 v; the pulses were sent to a computer. The analyzer, together with a photomultiplier and a NaI(Tl) crystal, was used to study the spectra of ^{60}Co, ^{137}Cs, and Hg. (TTT)

9258 THREE CHANNEL LOW SPEED COUNTER FOR MEASURING ALPHA PARTICLES. Roberts, P. B. Electron. Eng., 37: 784-7(Dec. 1965).

A fully transistorized instrument is described for measuring simultaneously the activities of three samples of alpha-emitting radioactive materials up to a few hundred pico-curies. Circuit diagrams are included. (L.B.S.)

9259 A REPETITIVE ELECTRONIC SWITCH FOR USE IN ISOTOPE RESEARCH. Lotz, E. van der S. (Fruit and Food Tech. Research Inst., Stellenbosch, S. Africa). Electron. Eng., 37: 825-7(Dec. 1965).

In experiments with short-lived isotopes and for certain statistical tests, it is sometimes necessary to operate a nucleonic pulse counter many times in succession for relatively short periods. An electronic switch is described by means of which such counters can be operated repetitively for predetermined periods of 1, 2, 4, 8, or 16 sec, with "off" periods of either 3 or 4 sec between consecutive "on" periods. The required timing sequence is generated by a 12-cathode glow-discharge tube, driven by pulses derived from rectified, unfiltered 50 c/s sine waves. Both full- and half-wave rectification are used, with switch-over from one mode of rectification to another by means of a small gas tetrode. (auth)

9260 PREPARATION OF ZnS(Ag) PHOSPHOR SCREENS FOR DETECTION OF α PARTICLES. Carfi, N. (Laboratori CISE, Milan). Energia Nucl. (Milan), 12: 661-2(Dec. 1965).

Two methods are presented for the preparation of ZnS(Ag) phosphor screens for the detection of alpha particles. In one method the ZnS(Ag) powder is dusted upon the support and a binder is then applied. In the other method the ZnS(Ag) is in solution with the binder, which is removed once the deposition is over. Experimental results obtained with the phosphor screens are included. (J.F.P.)

9261 DETERMINATION OF STATIONARY FIELD DOSES WITH A SCANNER. Schknecht, Guenter (Staedtische Auguste-Viktoria-Krankenhaus, Berlin). Fortschr. Geb. Roentgenstr. Nuclearmed., 101: 76-9(July 1964). (In German).

Knowledge of the dose distribution of fixed irradiation sources is the basis for any exact plan of teletherapy irradiation. A scanner ordinarily used for measurement of distribution of radioisotopes in organs and tissues can be used to scan the cross section of a beam if a dose rate meter is attached to the detector head. The isodose points recorded from the meter can be plotted to obtain a map or the dose rate distribution over the field scanned. By joining the points that represent equal dose rates the stationary field isodoses can be obtained. Because of the inertia of the dosimeter response the points measured

may be shifted somewhat. The trend of this shift can be corrected for if the scanning speed is decreased, but it is inadvisable to increase the measurement time too much. For this reason it is probably simpler to construct smoothed curves when plotting from the data obtained. If a field is measured without a filter it is advisable to measure the value of the dose intensity in the direction of the central beam, or to refer to a depth dose table. An example of measurement and plotting of a stationary depth dose field of a ^{60}Co teletherapy unit is described. (BBB)

9262 APPARATUS FOR MONITORING ^{239}Pu IN WOUNDS. **Epstein, R. J.; Johanson, E. W. (Argonne National Lab., Ill.). Health Phys., 12: 29-35(Jan. 1966).**

An instrument was designed for the detection of ^{239}Pu in wounds. The detector is a NaI(Tl) scintillation counter, optimized for the detection of soft x rays. With this apparatus it is possible to detect 5×10^{-4} μc of ^{239}Pu, as a distributed source, at the surface of a wound with a source count rate equal to that for the background. Resolution for 14.4-kev gammas is about 30 percent. At 6.4 kev the peak to low-energy-valley ratio is about 9 to 1. The detector is supported by a mechanism that is convenient for clinical use. An attendant optical system projects crossed light beams along the counter axis for convenient determination of the source location. Data are presented as a spectrum on a multichannel analyzer and as a display of the total number of counts in the energy region of interest. A discussion of error minimizing procedures is presented. (auth)

9263 HEAVY ION TRACKS IN NUCLEAR EMULSIONS: APPLICATIONS TO CHARGED PARTICLE DOSIMETRY. **Benton, E. V.; Tochilin, E. (Naval Radiological Defense Lab., San Francisco). Health Phys., 12: 49-52(Jan. 1966).**

Nuclear research emulsions, Ilford K.5, K.2, K.0, K minus 1, and K minus 2 were exposed to 10 Mev/nucleon heavy ion beams consisting of ^{40}Ar, ^{20}Ne, ^{16}O, ^{14}N, and ^{12}C having rates of energy loss in the range 0.35 to 5.2 Mev/μ. All emulsions of a given sensitivity were taken from a single batch and were exposed and processed at one time in order to permit intercomparison between tracks of the different ions in the various emulsions. Photomicrographs of the five types of ions in the five types of emulsions are presented. Relative merits of the various emulsions are discussed, as well as possible applications to heavy ion charged particle dosimetry. (auth)

9264 THERMAL FOGGING OF PERSONNEL MONITORING FILM. **Kathren, R. L. (Univ. of California, Livermore). Health Phys., 12: 61-3(Jan. 1966).**

Thermal fogging did not occur in personnel monitoring films held at temperatures below 50°C for up to 216 hr. Films maintained at temperatures above 50°C were fogged nonuniformly, with peak fogging occurring at relative humidities of 40 to 60 percent. The hypothesis stating that competing reactions from radiolytic products of water cause the humidity dependence of response to γ radiation is disproved. (auth)

9265 SHIELDING MEASUREMENTS FOR 3 Mev AND 15 Mev NEUTRONS. **Broerse, J. J.; Van Werven, F. J. (Radiobiological Inst. of the Organization for Health Research TNO, Rijswijk). Health Phys., 12: 83-93(Jan. 1966).**

With a view to determine the minimum thickness of shielding required for a neutron generator, the absorption characteristics of various materials were measured for neutrons produced through the T(d,n)^{4}He and D(d,n)^{3}He reactions. The shielding thickness required to reduce the transmitted dose to permissible levels of exposure was found to be determined by the reduction of the dose rate of the 15 Mev neutrons. Since the shielding is required for the protection of the operating personnel, the quantity of interest is the dose equivalent. This quantity was measured with a neutron rem detector for various shielding materials as a function of the shielding thickness. Attenuation curves are reported for water, concrete, paraffin and borated laminated wood. After the final shielding of the neutron generator was constructed, the radiation levels outside the shield were found to be below the maximum permissible values, as indicated by the instrumentation used. (auth)

9266 SIMPLIFIED WHOLE-BODY COUNTING. **Palmer, H. E. (Battelle Memorial Inst., Richland, Wash.). Health Phys., 12: 95-6(Jan. 1966). (BNWL-SA-197).**

Whole-body counting on the Shadow Shield Whole-Body Counter was compared to counting with a 3 × 3 in. NaI crystal placed in direct contact with the bodies of 28 adult male Eskimos. The counting rate from the in vivo ^{137}Cs and the background rate under the ^{137}Cs photopeak for the 3-in. crystal with no shielding were almost identical to those of the $4 \times 9\frac{3}{8}$ in. crystal in the shadow shield or iron room. Persons with low ^{137}Cs body burdens were used to determine background. The method is applicable to determining body burdens down to a few nanocuries and is best suited for internally deposited radionuclides such as Na, K, and Cs that are distributed throughout the body. (H.G.D.)

9267 BACKGROUND RADIATION MONITOR. **Splichal, W. F. Jr. (E. I. du Pont de Nemours and Co., Aiken, S. C.). Health Phys., 12: 99-101(Jan. 1966). (DPSPU-64-30-17A).**

An inexpensive, yet accurate radiation monitor is described in which an electrostatic relay replaces the vibrating reed electrometer that is ordinarily used to measure the output from background radiation detectors. Accuracy of the monitor is estimated to be ±10 percent. Sensitivity under laboratory conditions is about 39 μR for each registered unit. The monitor is not significantly affected by normal changes in temperature, pressure, and humidity under laboratory conditions, and its counting circuit is not subject to drift. (H.G.D.)

9268 A HIGH RESOLUTION ALPHA PARTICLE SPECTROMETER FOR VERY LOW SPECIFIC ACTIVITY SAMPLES. **Osborne, R. V.; Hill, C. R. (Inst. of Cancer Research, Belmont, Surrey, Eng.). Health Phys., 12: 103-4(Jan. 1966).**

Design and application of an alpha particle spectrometer that will accommodate sources up to 1500 cm^2 in area and that has a resolution of about 50 kev are briefly discussed. (H.G.D.)

9269 RADIATION MONITORING—AN INSTRUMENTATION SYSTEM FOR CONTROL OF RADIATION HAZARDS. **Eastman, R.; Gallagher, J. M. Jr. (Westinghouse Electric Corp., Pittsburgh). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci., NS-12: 15-21(Dec. 1965).**

The requirements for radiation monitoring from an integrated instrumentation system aspect are developed with emphasis on the detection and control of radiation hazards. General treatment is given to the problems and equipment involved in operational or process monitoring, site monitoring, effluent monitoring and area or personnel monitoring. The types of radiation that are encountered in a nuclear plant and the units of measurement that are used are discussed. A review of the types of monitoring equipment that are presently available to make plant and personnel measurements and their sensitivity and reliability as related to meeting accepted standards for plant personnel and general public protection is given. A typical radiation monitoring system and the basis for the design are described. A brief summary of the status of development of solid state monitors is included. (auth)

9270 SINGLE WIRE-PLATE ALPHA PARTICLE COUNTER CHARACTERISTICS IN AIR. **Harrison, A. W. (Brighton Coll. of Tech., Sussex, Eng.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci., NS-12: 48-52(Dec. 1965).**

Spark and corona-streamer characteristics were obtained for a wire-plate alpha particle counter having an electrode gap 1.27 mm–12.7 mm and a wire diameter

0.07 mm–0.5 mm. Applied voltages up to 22 kv were employed. The working characteristics for different quenching resistances R are reduced to a single fundamental characteristic independent of R. Conditions are given for attaining a flat counting characteristic plateau in both the sparking mode and corona-streamer mode of operation. (auth)

9271 RADIOACTIVE ASSAY OF BULKY SAMPLES. Paix, D.; Davis, A. E.; Blagonravoff, L. (Prince Henry Hospital, Little Bay, New South Wales). J. Coll. Radiol. Austral., 9: 268-71(Oct. 1965).

A well-type scintillation counter is described that is capable of correctly counting samples up to 600 ml without any prior preparation such as homogenation. Using any isotope emitting γ rays at least as penetrating as those of ^{51}Cr, the sensitivity is adequate for clinical purposes and results in the use of appreciably smaller doses of tracer. Small animals such as rats may be counted in whole-body fashion. (H.G.D.)

9272 SIMULTANEOUS USE OF TWO RADIOISOTOPES BY SCANNER PLUS ANALOGUE COMPUTER COUPLING. Spencer, Richard P. J. Nucl. Med., 6: 844-6(Nov. 1965).

By direct coupling of a radioisotope scanner to an analog computer, it is possible to scan one radioisotope in the presence of a second, or to scan two radioisotopes simultaneously. (auth)

9273 ACTIVATION NEUTRON INTEGRATORS. David, L. Jad. Energ., 11: 288-95(Aug. 1965). (In Czech.).

The problem of the determination of long-term integral doses of neutron irradiation from a nuclear reactor by means of an activation method is treated. The main attention is given to the original consideration of basic uncertainty of this method caused by time variability of absolute neutron flux in a nuclear reactor during long exposure times. In connection with this a new value, the so called maximum uncertainty interval, is defined and its width is determined in the dependence on the exposure time interval. Further the activation integrators used and their most important properties are noted. (auth)

9274 CONSTRUCTION OF THE LARGE HYDROGEN BUBBLE CHAMBER FOR CERN. Sommer, H. (S. A. des Ateliers de Secheron, Geneva). Kerntechnik, 7: 490-5(Nov. 1965). (In German).

The design of the hydrogen bubble chamber, its technical characteristics, and its construction are described. (J.S.R.)

9275 A SIMPLE PRINTING PROCEDURE FOR ELECTRONIC COUNTERS. Attwenger, W.; Petreczek, K. (Oesterreichische Studiengesellschaft fuer Atomenergie, Seibersdorf, Austria). Kerntechnik, 7: 499-503(Nov. 1965). (In German).

A simple printing procedure for electronic counters is given. The following conditions were fulfilled in the procedure: use of pulse counter with EIT decades, no connection in the EIT decades and as low as possible change of the counter, maintenance of the counting results, use of an addition machine with self-control as printer, use of inexpensive transistors and diodes for the circuits, simple operation and test possibility in a large operational range, and capacity for additional counters with the use of only one addition machine. The circuits constructed are given. (J.S.R.)

9276 AN ALPHA SPECTROMETER WITH SEMICONDUCTOR SURFACE BARRIER DETECTOR. Finsterwalder, L. (Technische Hochschule, Munich). Kerntechnik, 7: 515-17(Nov. 1965). (In German).

A spectrometer using a semiconductor surface barrier detector was constructed. The spectrometer consists of two parts, the vacuum chamber with the semiconductor surface barrier detector and the charge-sensitive preamplifier. The wiring diagram of the preamplifier is given and the results of tests on its linearity using a series of alpha preparations are reported. (J.S.R.)

9277 THE IONIZATION MECHANISM IN RADIOACTIVE IONIZATION DETECTOR. Tsuge, Shin; Takeuchi, Tsugio (Nagoya Univ., Japan). Kogyo Kagaku Zasshi, 68: 1661-4(Sept. 1965). (In Japanese).

In a previous paper, the analysis of inorganic gasses using radioactive ionization detector with a 100 μC RaD alpha source, was reported. As a part of this work, some considerations about ionization mechanism of molecules with ionization potential above 11.6 ev are given. On the basis of following experimental results, namely, complex dependence of the detector response on the sample size, the potential applied to the detector and the contamination of carrier gas with organic vapors, the ionization mechanism is explained in terms of such phenomena as Penning Effect, direct ionization by energetic electrons and alpha particles, quenching of metastable argon atoms by nonionization collisions with molecules with ionization potential above 11.6 ev and formation of molecular ion. Oxygen and nitrogen, separated from air by gas chromatographic column packed with Molecular Sieve 5A were used as the sample gas with ionization potential above 11.6 ev. Argon containing organic vapor, helium and hydrogen were used as the carrier gas. (auth)

9278 USE OF DIMETHYL SULPHOXIDE IN LIQUID SCINTILLATION COUNTING. Wright, Evan; Millar, K. R. (Wallaceville Animal Research Centre, Wellington, N. Z.). Nature, 208: 889(Nov. 27, 1965).

The use of dimethyl sulfoxide as a scintillation solvent is discussed. By means of carbon-14-labeled hexadecane, the effect of dimethyl sulfoxide on the counting efficiency of toluene phosphors was determined. Concentrations up to 13% dimethyl sulfoxide enhanced rather than quenched the scintillations. (H.G.D.)

9279 SURVEY OF HEALTH PHYSICS INSTRUMENTS. Evans, H. D. (Imperial Coll., London). Nucl. Eng., 10: 459-64(Dec. 1965).

The portability, speed, and accuracy requirements of health physics instruments are outlined. Personal dose measuring devices are discussed, including x- and gamma-ray film badges, pocket ionization dosimeters, thermoluminescent dosimeters, and neutron film and activation dosimeters. The design, sensitivity, range, and robustness of various types of dose rate meters, using ionization chambers, G-M tubes, and scintillation counters, are described. Types of available contamination monitors are considered. Problems in neutron monitoring are mentioned. Air and effluent monitoring are discussed. Monitors for hand and clothing contamination are mentioned. The danger in developing instruments with a high versatility rather than inexpensive single-purpose instruments is emphasized. (M.J.T.)

9280 GEOMETRIC CORRECTIONS FOR γ-γ DIRECTION CORRELATION MEASUREMENTS WITH LINEAR SOURCES AND CYLINDRICAL DETECTORS. Uhl, Mario. Oesterr. Akad. Wiss., Math.-Naturwiss. Kl, Anz., 101: 277-83(1964). (In German).

The geometric corrections for γ-γ direction correlation measurements with linear sources and cylindrical detectors were calculated with a consideration of an angular dependence of the detection probability and without limitation with respect to the aperture angle of the cylindrical detectors. (J.S.R.)

9281 CALIBRATION OF RADIOACTIVE SOURCES BY A γ-γ COINCIDENCE METHOD. Hille, P. Oesterr. Akad. Wiss., Math.-Naturwiss. Kl., Anz., 101: 393-7(1964). (In German).

A calibration method of great accuracy that depends on the detection of γ radiation is described. The measurements can be made on sealed preparations and is usable for nuclides with simple decay schemes such as ^{60}Co and ^{24}Na. It can also be used for nuclides that emit only γ quanta of equal intensity in cascade. The theory of the method and the corrections necessary are reported. (J.S.R.)

9282 DETECTION OF 30 AND 40 Mev PROTONS BY A THIN-WINDOW LITHIUM-DRIFTED GERMANIUM

COUNTER. Pehl, R. H.; Landis, D. A.; Goulding, F. S.; Jarrett, B. V. (Univ. of California, Berkeley). Phys. Lett., 19: 495-6(Dec. 1, 1965).

The response of thin-window lithium-drifted germanium counters is investigated. Corrections were made for the spread of the beam energy, the thin window, and electronic noise. The remaining spread was found to be 21 kev for 30-Mev protons, and 30 kev for 40-Mev protons. Also the theoretical limitation of the energy resolution is given as a function of the energy deposited in a germanium crystal for different non-detector contributions. (J.F.P.)

9283 PHYSICAL AND ABSTRACT PRINCIPLES OF DOSIMETRY. Berger, H. (Siemens-Reiniger-Werke Ag, Erlangen, Ger.). Radiologe, 4: 237-45(Aug. 1964). (In German).

The abstract concept of radiological dose used today can be derived as a degradation of schema from the physical nature of radiation reactions in materials and their relation to biological irradiation effect. Ionometric dose measurements are the standard method used in practice for dosimetry. It provides a substitutive method for measurement of dose in the patient's body where direct measurements cannot be made, and is related to the condition of secondary particle equilibrium between the measurement volume and its environment. Two requirements must be met for this type of measurement. One is that there must be secondary particle equilibrium in order to measure the standard ion dose in an undisturbed x or γ radiation field. The second requirement is for Δ electron equilibium for measurement of the ion dose in an undisturbed electron field. The definitions of the dosimetric magnitudes, such as energy dose, ion dose, standard ion dose, etc., and their units are discussed. The use of basic principles of dosimetry in dose measurement within phantoms and the estimation of dose in patients also is discussed briefly. (BBB)

9284 ELECTRON BEAM SPECTROSCOPY. Klemperer, O. (Imperial Coll. of Science and Tech., London). Rep. Progr. Phys., 28: 77-111(1965).

Some recent techniques of producing electron beams with narrow energy distributions and various methods for measuring these energy distributions are reviewed. A description and discussion of energy analyzers for studying the energy spectra of the electron beams after they have been transmitted through gases or through solids are given. The emphasis is on progress during the last ten years, but a brief survey of earlier developments of the subject is added. (auth)

9285 LARGE GAS FILLED CERENKOV COUNTER. Frankel, S.; Highland, V.; Sloan, T.; van Dyck, O.; Wales, W.; Wolfe, D. (Univ. of Pennsylvania, Philadelphia). Rev. Sci. Instrum., 37: 15-18(Jan. 1966). (PPAD-2137-555).

A large pressurized gas Cherenkov counter is described. The counter is designed to assist triggering on electrons in high energy counter-spark chamber experiments. The requirement of large solid angle resulted in a counter of large dimensions and heavy construction. The results of tests made on the counter are presented. The tests indicate that the counter rejects pions very well and is roughly 50% efficient to electrons in the Λ^0 beta-decay spectrum (0–200 Mev). (auth)

9286 IONIZATION DISCRIMINATION PROPERTIES OF SPARK CHAMBERS. Grieder, P. K. F. (Univ. of Bern). Rev. Sci. Instrum., 37: 80-2(Jan. 1966).

Spark chamber behavior with respect to heavy and minimum ionizing particles is investigated in an attempt to find suitable gases and modes of operation that would permit ionization discrimination. Chambers having a gap of 10 ± 0.05 mm and fillings of pure helium, pure argon, and helium–argon mixtures were analyzed. It was found that for the given modes of operation only argon-filled chambers show useful ionization discrimination properties, while chambers with pure helium fillings have practically none. The results obtained for helium–argon mixtures are better than those for pure helium but inferior to those obtained for pure argon fillings. Curves showing the chamber responses with respect to ^{210}Po alpha and minimum ionizing particles are presented for helium and for argon filled chambers. The effect of gas contamination is discussed and some data are given. (auth)

9287 IMPROVEMENTS TO A SPARK CHAMBER SYSTEM FOR HIGH ENERGY γ-RAY DETECTION. Guerriero, L.; (Univ., Padova); Massimo, J. T.; Salandin, G. A.; Voci, C. F.; Lanou, R. E.; Pifer, A. E.; Brabson, B. B.; Rosenson, L. Rev. Sci. Instrum., 37: 118-20(Jan. 1966).

Modifications which include a new spark gap design were made of a previously described gamma-ray spark chamber detector. The chamber performance was greatly improved for detecting gamma rays from the π^0's in the $\pi^- + p = N + n\pi^0$ interaction. (L.B.S.)

9288 ON THE PRINCIPLE OF A RADIATION DETECTOR. Varshneya, N. C. (Univ. of Roorkee, India). Univ. Roorkee Res. J., 8: 3p.(1965).

Water was supercooled to $-20°C$. It did not freeze for more than half an hour, after which ^{60}Co was placed over the container. A thin layer of ice with needle-like projections into the liquid was observed at the inner surface of the spot of exposure. The supercooled water is in a metastable state, and nucleation is possible if a group of water molecules can form an ice-like configuration. A basis is thus provided for construction of a particle detector. It is expected that the ice crystals formed along the path of radiation would maintain the sharpness of the track for a conveniently short period because of a comparatively slow rate of growth of solid phase in liquid, thus affording convenience in photography. The problem of erasure of the tracks and of rendering the same sample of liquid again serviceable for fresh recording is essentially one of transient, local heating. (J.F.P.)

9289 SPARK SPECTROMETER FOR HIGH-ENERGY PARTICLES. Takibaev, Zh. S. (Academy of Sciences, Kazakh SSR). Vestn. Akad. Nauk Kaz. SSR, 22: No. 8, 3-9 (Aug. 1965). (In Russian).

After reviewing the difficulties involved in determining the energy of high-energy particles (10^{11} ev) from track curvatures with ionization chambers, movable films, and other methods, a spectrometer design consisting of several spark chambers, Fe absorbers, and scintillators is proposed. The use and operation of the spectrometer are discussed in extensive detail. Also, variations in configuration are proposed; e.g., one in which spark chambers, scintillators, and Fe absorbers are alternated in a stack. In this design the plastic scintillators or the vessels containing the scintillation liquid have a special shape to compensate for the emitted light with respect to the photomultipliers. (JPRS)

9290 MEASUREMENT OF DELAYED NEUTRONS. [Thesis]. Hahn, Ottfried Johannes. Princeton, N. J., Princeton Univ., 1964. 219p.

A laboratory experiment was designed to measure delayed neutron and delayed photoneutron groups using a neutron generator with the ^{3}H(^{2}H,n)^{4}He reaction instead of a nuclear reactor as a neutron source. A large liquid scintillation neutron counter (using methyl borate and toluene) with pulse shape discrimination against gamma rays was developed for this experiment. This counter also distinguishes between protons resulting from fast neutrons and alpha particles resulting from the ^{10}B(n,α)^{7}Li reactions. The delayed neutron half lives as measured by G. R. Keepin et al., at Los Alamos in 1956, which were in slight disagreement with earlier measurements, were reproduced for four of the six delayed neutron groups. (Dissertation Abstr.)

9291 RECENT IMPROVEMENTS IN RADIOPHOTOLUMINESCENT DOSIMETRY. Yokota, Ryosuke; Nakajima, Saburo (Tokyo Shibaura Electric Co., Ltd.). 28p. (CONF-650637-7). ORINS. Gmelin, AED-CONF-65-151-5.

From International Conference on Luminescent Dosimetry, Palo Alto, Calif.

The improvements in radiophotoluminescent dosimetry include consideration of measurement errors, new glass with higher sensitivity and better durability for weathering, improvement of the fluorimeter, and a convenient method for photon, both gamma and x ray, dose measurements. Other topics include a gold sheath shielding case for fluorod, and a discussion of the dosimeter performance. (J.F.P.)

9292 PHOSPHATE GLASSES AS ROUTINE PERSONNEL DOSIMETERS. Maushart, R.; Piesch, E. (Nuclear Research Center, Karlsruhe, Ger.). 15p. (CONF-650637-6). ORINS. Gmelin, AED-CONF-65-151-7.

From International Conference on Luminescent Dosimetry, Palo Alto, Calif.

The use of silver-activated phosphate glasses in radiation dosimetry is discussed. Dosimeter combinations for quantum radiation as used in the Karlsruhe Nuclear Research Center are described. A spherical dosimeter was developed for measurements above 40 kev. The plan for routine evaluation of the dosimeters is also described. (M.C.G.)

9293 IMPROVEMENTS IN OR RELATING TO BETA RADIATION MONITORS. Halton, Dennis Lewin (to The Plessey Co., Ltd.). British Patent 1,010,902. Nov. 24, 1965. Filed Mar. 20, 1961.

A device is patented for monitoring beta radiation from radioactive material that is above or below a predetermined level. A Geiger-Mueller tube is used as a detector, and the signal from the detector resulting from both beta and gamma radiation is compared with a signal from the detector when a shutter arrangement is provided that simultaneously shields the detector from external beta radiation and exposes it to a beta source of known intensity whose radiation is equivalent to the intensity of the external radiation at which the device is required to operate an alarm. Electronic circuits compare the signals from the detector with the shutter absent and in place; and when the external beta radiation is above a preset level, the output voltage from an amplifier exceeds the preset level to operate an alarm circuit including a visual or audible alarm device. (B.L.M.)

9294 POCKET APPARATUS FOR DETECTION AND MEASUREMENT OF NUCLEAR RADIATION. Schneider, Reinhard. German Patent 1,198,462. Aug. 12, 1965. Filed Jan. 26, 1959.

The instrument consists of a pulse-type detector the pulses of which are stretched and integrated with different time constants in relation to the pulse rate. Power consumption is also controlled simultaneously by the pulse rate. (Gmelin Inst.)

9295 RADIATION FLUX MEASURING DEVICE. Muto, Haruo (to Tokyo Shibaura Electric Co., Ltd.). Japanese Patent 1964-18445. Aug. 31, 1964. Filed June 14, 1962.

The device proposed measures the flux of a radiation such as charged particles, neutrons, or electromagnetic radiation, and measures the amount of disintegration of elements activated by the radiation. The device is particularly useful for activation analyses. The apparatus indicates the radiation flux as an electrical output, which is passed through an integrating circuit before being sent to the indicator. The integrating circuit has a time constant equal to the reciprocal of the disintegration constant of the element activated by the radiation flux. (NSA of Japan)

9296 LOW-BACKGROUND β-RAY DETECTOR. Tanaka, Eiichi. (to National Inst. Radiol. Scis.). Japanese Patent 1964-21573. Oct. 1, 1964. Filed Mar. 6, 1961.

A low-background β-ray detector is provided, which can determine the energy distribution of β rays or count the β rays in a given range of energy. The detector consists of a plastic scintillator with a small cavity, a photomultiplier tube, an optical conductor, an anode for the gas-flow G-M tube, a thin-film window, a packing sheet through which the gas flows, and a sample compartment. The plastic scintillator detects the radiations from hard cosmic rays, and the gas-flow counter detects β rays from the sample in the sample compartment and also radiations from the cosmic rays. (NSA of Japan)

9297 LOW BACK-GROUND β-RAY ENERGY ANALYZER USING COINCIDENCE COUNTING. Tanaka, Eiichi (to National Inst. Radiol. Scis.). Japanese Patent 1964-21574. Oct. 1, 1964. Filed Mar. 6, 1961.

A low-background β-ray energy analyzer is provided, which determines the energy distribution of β-rays or counts the β-rays in a given energy range. The analyzer consists of a scintillation β-ray counter having a satisfactory thickness of scintillator for detecting and absorbing the hard cosmic rays, a β-ray detector constructed in the cavity of the β-ray scintillator, and coincidence counting circuits. The analyzer counts only the simultaneous pulses from the β-ray detector and β-ray scintillator, reducing the background due to the γ rays and cosmic rays. (NSA of Japan)

9298 LOW BACKGROUND β-RAY ENERGY ANALYZER USING RETRO-COINCIDENCE COUNTING. Tanaka, Eiichi. (to National Inst. Radiol. Scis.). Japanese Patent 1964-21575. Oct. 1, 1964. Filed Mar. 6, 1961.

A low-background β-ray energy analyzer is provided, which determines the energy distribution of β rays or counts the β rays in a given energy range. The analyzer consists of a scintillator β-ray counter having a satisfactory thickness of scintillator for detecting and absorbing the hard cosmic rays, a β-ray detector constructed in the cavity of the β-ray scintillator, and a coincidence counting circuit with a pulse height limiter. The analyzer counts only the simultaneous pulses having a selected range of energies and excludes the high-energy background pulses from the cosmic rays. (NSA of Japan)

9299 BUBBLE CHAMBER ILLUMINATION MEANS. Rosin, S.; Palmer, R. B. (to U. S. Atomic Energy Commission). U. S. Patent 3,226,539. Dec. 28, 1965.

A means was developed for providing a high-flux, undistorted, extended light source and for introducing the high-flux light from this source into an enclosure through a restricted window, such as is provided in a large bubble chamber for detecting nuclear interactions. Equipment is provided for producing a single source image by source duplication from two extended lamps, such as xenon flash tubes, and for providing a cylindrical lens system for receiving and condensing the light from the single source image and transmitting this light in a convergent bundle with spherical power for uniformly transmitting the luminous flux into the enclosure. (AEC)

Radiation Effects

9300 (IAE-949) VLIYANIE IZLUCHENIYA REAKTORA NA RABOTY TSEZIEVOGO DIODA. (Effect of Reactor Radiation on Performance of Cesium Diode). Kondrat'ev, F. V.; Sinyutin, G. V.; Tikhonov, V. F. (Institut Atomnoi Energii, Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow). 1965. 10p. Dep. mn.

It was shown that the radiation field of a reactor changes the current-voltage characteristics during operation of a cesium diode of simple construction. At different operating regimes of the diode this change can lead to a decrease of the power taken from the converter as well as its increase. (tr-auth)

9301 (IDO-17103) TRANSIENT NUCLEAR RADIATION EFFECTS ON TRANSDUCER DEVICES AND ELECTRICAL CABLES. Terry, F. D.; Kindred, R. L.; Anderson, S. D. (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). Nov. 1965. Contract AT(10-1)-205. 76p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

Tests were conducted on several types of transducers and electric cables to determine their suitability for use in transient radiation fields and to develop techniques

for compensating some of the transducers for radiation effects. Transient radiation effects on strain gauge, inductive, capacitive, piezoelectric, photoresistive, and infrared transducers were measured in fluxes reaching 1.2×10^{16} nv and 2.3×10^{7} rads/sec. Radiation effects on single conductor and coaxial leadout cables were investigated for correlation with transducer data. Several techniques of compensating transducers for transient radiation effects were experimentally shown to provide greater than 90 percent reduction in generated spurious signals. Other compensation techniques were suggested, but have not yet been experimentally verified. (auth)

9302 (RLDP-65-13) EFFECT OF OPERATING CONDITIONS AND TRANSISTOR PARAMETERS ON GAIN DEGRADATION. Frank, Max; Larin, Frank (Bendix Corp., Southfield, Mich. Research Labs. Div.). [1965]. Contract AF29(601)-6316. 9p. (CONF-650707-17).

From IEEE Annual Conference on Nuclear and Space Radiation Effects, Ann Arbor, Mich.

Data for predicting transistor gain degradation in a neutron radiation environment were obtained from experimental studies of the variation of the radiation damage constant K_τ as a function of temperature and current during both measurement and irradiation. Relatively small spreads in the values of K_τ were obtained when the individual base transit times were measured and the radiation exposures were precisely determined. Radiation damage effect data from 20 different n-p-n silicon transistor types were obtained and normalized to the same minority carrier concentration in the base region, using the transit time and the V_{BE} -I_c characteristics of the specific transistors. The resulting relative dispersions of the damage constant for minority carrier densities of $10^{15}/cm^3$ and $10^{16}/cm^3$ were typically 15 to 20 percent. These dispersions indicate that electrical measurements of transistor physical parameters can provide reasonably accurate predictions of the gain degradation for a wide variety of transistors without additional radiation testing of specific transistor types. (auth)

9303 THE SIMULATION OF SPACE RADIATION DAMAGE TO SPACECRAFT SYSTEMS. Price, William E. (Goddard Space Flight Center, Greenbelt, Md.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci., NS-12: 2-7 (Dec. 1965).

A search is made for the adequate laboratory simulation technique for future spacecraft to extend the useful lifetime of spacecraft and prevent premature failures. The choice of the quipment for carrying out laboratory simulations at Goddard Space Flight Center was made by an analysis of damage produced in semiconductor devices. The relative damage produced in semiconductors with various particle energies was compared with the number of those particles at each energy in space to produce a curve showing the particle energies which are most damaging in space. From the curves it is found that energies from about 1 to 4 Mev are the most damaging for electrons and protons. Therefore, the Goddard Space Flight Center will have a facility with a 0.5–3 Mev electron accelerator, a 0.5–4 Mev proton accelerator and a 0.1–1 Mev proton-electron accelerator, to cover the low energy range. The facility will also have a 30,000 curie cobalt 60 area capable of radiating whole spacecraft to simulate ionization damage effects. With these facilities a reasonable program of radiation hardening of long-lived spacecraft may be carried out. (auth)

9304 TRANSIENT RADIATION-INDUCED RESPONSE OF MOS FIELD EFFECT TRANSISTORS. Sullivan, D. C. (International Business Machines Corp., Owego, N. Y.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci., NS-12: 31-7(Dec. 1965).

It was found that the radiation-induced leakage current across the gate-to-substrate and the drain-to-substrate semiconductor junction dominates the behavior of MOS field effect transistors for small gate impedances. The smaller radiation-induced gate leakage current consists, to a large extent, of components due to secondary emission and air ionization effects. For large gate impedances, the gate leakage current can be important because of a modulation of the gate bias. The voltage dependence of this leakage current is also discussed. Based upon these findings and the physical structure of the device, an equivalent circuit model was developed to predict the behavior of devices of this type in a transient radiation environment. The model is suitable for use with existing automated circuit prediction techniques and contains parameters measurable with standard instrumentation procedures. (auth)

9305 SURFACE EFFECTS OF SPACE RADIATION ON SILICON DEVICES. Hughes, H. L. (Naval Research Lab., Washington, D. C.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci., NS-12: 53-63(Dec. 1965).

A metal-oxide-semiconductor (MOS) structure was used to study the effects of radiation on the silicon-silicon dioxide interface. From the capacitance versus voltage characteristics of irradiated MOS transistors it was confirmed that a major contribution to the radiation-surface degradation in silicon planar devices is the buildup of positive space charge in the silicon dioxide films covering the silicon-device surfaces. This space charge is mobile and able to drift by motion in electric fields. This positive charge can be accumulated at certain areas of the surface causing the silicon surface to have a tendency to go n type. (L.B.S.)

9306 STUDY OF THE EFFECTS OF FAST NEUTRONS ON SILICON CONTROLLED RECTIFIERS. Leith, F. A.; Blair, John (Massachusetts Inst. of Tech., Cambridge). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci., NS-12: 64-8(Dec. 1965).

Medium power silicon controlled rectifiers were exposed to a maximum integrated fast-neutron flux of 4×10^{13} nvt. An increase in the current required to turn on the controlled rectifier and an increase in the break-over voltage were observed after irradiation. The saturation voltage increased as a result of irradiation, exceeding 200 volts at an integrated fast neutron flux of 4×10^{13} nvt. These changes are attributed to a decrease of the minority carrier lifetime. (auth)

9307 EFFECTS OF NEUTRON IRRADIATION ON DIODE NOISE. Hayakawa, Shigeru; Echikawa, Kiyoshige (Matsushita Electric Industrial Co., Ltd., Osaka). J. Nucl. Sci. Technol. (Tokyo), 2: 476-7(Nov. 1965).

The results of an experimental investigation of the effects of neutron irradiation on diode noise are presented. It was found that there are no serious changes in noise after irradiation for 30 min with a neutron flux of 10^9/sec and that the noise induced during irradiation is remarkably high for a power diode with a large junction area. The induced noise is white and disappears as soon as irradiation ceases, indicating that the induced noise is probably due to an electron-voltaic effect. (D.C.W.)

9308 AN EXPERIMENTAL INVESTIGATION OF THE BEHAVIOUR OF A SPHERICAL IONIZATION CUM VACUUM CHAMBER. Burlin, T. E.; Husain, S. R. (The Polytechnic, London). J. Sci. Instrum., 42: 800-5(Nov. 1965).

A spherical chamber used in an experimental study of the saturation characteristics of an irradiated vacuum chamber and an ionization chamber is described. The measures adopted to minimize the distortion of the radial field in the instrument and to maintain a vacuum of 10 μ torr are outlined. The results obtained from the use of the apparatus are presented and critically discussed in the light of recent work in this field. (auth)

9309 METHOD FOR PRODUCING A THERMOELECTRIC ELEMENT. Fujiwara, Shinji (to Matsushita Electric Industrial Co., Ltd.). Japanese Patent 1964-14727. July 25, 1964. Filed Nov. 14, 1962.

The material for a thermoelectric element is irradiated before fabrication at a suitable radiation dose, keeping the superheating of the material at a minimum. This decreases the heat conductivity of the material and hence increases the effective index Z. By the proposed irradiation method the conversion of semiconductors from the p- to the n-type or from the n- to the p-type is possible. (TCO)

ISOTOPE TECHNOLOGY

General

Refer also to abstract 10276.

9310 STABILITY OF BARE ^{210}Po SOURCES. Diethorn, W. S. (Pennsylvania State Univ., University Park). Int. J. Appl. Radiat. Isotop., 16: 705-10(Dec. 1965).

Loss of ^{210}Po activity from bare, polonium metal sources is expected from both evaporation and knockout of surface atoms. Knockout by recoil ^{206}Pb atoms is much greater than knockout by α particles. Evaporation exceeds knockout at moderate surface temperatures and so forced cooling of even small sources is necessary to minimize loss of polonium. The theory of both mechanisms and the buildup of activity outside a source in a vacuum are discussed. (auth)

Industrial Applications

Refer also to abstract 8839.

9311 (CONF-650902-26) ELEMENTS OF RADIATION FACILITY DESIGN. Dietz, George R. (Division of Isotopes Development (AEC), Washington, D. C.). [1965]. 12p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

From American Chemical Society, 150th National Meeting, Atlantic City.

The factors that must be considered in the decision to use radiation processing and in the design of an irradiation facility are briefly discussed. (D.C.W.)

9312 (CONF-651024) RADIATION PASTEURIZATION OF FOODS. Summaries of Accomplishment Presented at Fifth Annual Contractors Meeting, October 20-21, 1965. (Division of Isotopes Development (AEC), Washington, D. C. Division of Biology and Medicine (AEC), Washington, D. C.). [nd]. 210p. Dep. mn; CFSTI $6.00 cy, $1.25 mn.

Separate abstracts were prepared on thirty-three sections of this report. One section was abstracted previously and appeared in NSA Vol. 19: 36874. (C.H.)

For abstracts of individual sections see: 9313–9345.

9313 (CONF-651024, pp 3-6) RADIATION PRESERVATION OF FISH AND SHELLFISH OF THE NORTHWEST ATLANTIC. Ronsivalli, Louis J. (Bureau of Commercial Fisheries, Gloucester, Mass. Technological Lab.).

Results are reported from research on the radiation processing of fish and shellfish. Emphasis was placed on the evaluation of the effects of radiation and storage on organoleptic and bacterial qualities of the products. Optimum dose studies indicated that 150,000 rads radiation is the dose of choice for cooked lobster meat. Large scale laboratory experiments established the shelf life of irradiated cod fillets prepared from iced fish of decreasing quality and indicated that iced fish held for 9 days or more does not give a good quality product. The shelf life of irradiated fillets was at least double that of nonirradiated controls. Most plastics tested proved to be good barriers against bacterial contamination of irradiated fish fillets. Studies of Clostridium botulinum Type E toxin in irradiated fish products showed that the shelf life of 20 to 30 days of irradiated fish fillets was significantly less than the time required for toxin development. Preliminary results are reported from studies of the inhibitory effects of sodium nitrite, sodium benzoate, and sodium tripolyphosphate, on the growth of Clostridium botulinum Type E in fish homogenates. (C.H.)

9314 (CONF-651024, pp 7-9) OPERATIONS OF THE MARINE PRODUCTS DEVELOPMENT IRRADIATOR. Kaylor, John D. (Bureau of Commercial Fisheries, Gloucester, Mass. Technological Lab.).

The first 7-mo operation of the Marine Products Development Irradiator is reviewed. Over 10,000 lb of fishery and other food products were irradiated at doses ranging from 5,000 to 800,000 rads. Design modifications to extend the dosage above or below the present limitations are discussed. A survey on the quality of fresh fish showed that 85% of the haddock landed at Boston is of a quality suitable for radiation processing. (C.H.)

9315 (CONF-651024, pp 10-13) APPLICATION OF RADIATION-PASTEURIZATION PROCESSES TO PACIFIC CRAB AND FLOUNDER. Miyauchi, David; Spinelli, John; Pelroy, Gretchen (Bureau of Commercial Fisheries, Seattle, Wash.).

Irradiation of Dungeness crab meat in the dose range 0.1 to 0.2 megarad resulted in a product with a storage life of 2 to 5 weeks, which is 5 times greater than that of the nonirradiated product. Elimination of air from packaged halibut steak irradiated at 0.2 megarad minimized the development of rancidity. Irradiation of vacuum-packed petrale sole fillets at 0.1 and 0.15 megarad resulted in a storage life at 33°F of 20 to 25 days, which is 2 to 3 times that of the unirradiated sample. Studies showed that the atmosphere surrounding fish fillets during irradiation has a definite effect on ultimate product quality. Air, nitrogen, and CO_2 produced oxidizing substances that reacted with the substrate, but introduction of nitrogen into the package after irradiation protected fish from subsequent off-color and rancidity. Studies on fish tissue nucleosides showed that these compounds, or their corresponding nucleosides and free bases, serve as useful indicators of the freshness of fish. The contribution of microflora existing in fish to the observed spoilage patterns of radiation processed fish was studied and the predominant organisms involved were identified as Pseudomonas, lactic acid bacteria, Achromobacter, and aerobic yeasts. (C.H.)

9316 (CONF-651024, pp 14-17) RADIATION PASTEURIZATION OF GULF SHELLFISH. Novak, Arthur F.; Liuzzo, Joseph A. (Louisiana State Univ., Baton Rouge. Dept. of Food Science and Technology).

Liquid nitrogen coolant was used to maintain shrimp at 28 to 31°F rather than the slightly higher iced storage temperature of 33 to 35°F. The lower temperature improved the quality of radiation processed shrimp. Results of field tests of radiation processed oysters stored in ice showed a preference for irradiated over non-irradiated oysters after 18 days of storage. An assay of the stability of B vitamins in oysters irradiated at 0.2 and 0.6 M rad showed that the vitamins were partially destroyed. Ten strains of bacteria that were resistant to 0.1 M rad of γ radiation were isolated from oysters but total and coliform bacterial counts were greatly reduced after irradiation. (C.H.)

9317 (CONF-651024, pp 20-3) IRRADIATION PRESERVATION OF FRESH WATER FISH. Seagran, H. L.; Emerson, J. A.; Kazanas, N.; Gnaedinger, R. H.; Krezeczkowski, R. (Bureau of Commercial Fisheries, Ann Arbor, Mich.).

Progress is reported in a study of applications of γ radiation at substerilization doses to extend the refrigerated shelf life of yellow perch fillets and smoked chub. Bacteria isolated from fresh fish were identified and the residual flora during storage after irradiation at doses of 0.3 and 0.6 megarad were identified as Achromobacter-alcaligenees group organisms. Irradiation at these doses eliminated proteolytic activity of the bacteria. A study of bacterial contamination due to handling showed a 200-fold increase after processing into fillets at the plant. The

effects of temperature during irradiation of raw fish on the flavor of the smoked product and the effects of radiation doses of 4 megarads and storage temperature on thiaminase activity of whole fish were investigated. (C.H.)

9318 (CONF-651024, pp 24-30) THE EFFECT OF RADIATION ON THE MICROBIAL FLORA SURVIVING RADIATION PASTEURIZATION OF SEAFOODS. Sinnhuber, R. O.; Lee, J. S. (Oregon State Univ., Corvallis. Dept. of Food Science and Tech.).

The effects on radiation processing of dover sole, Dungeness crab, and Pacific oysters on the characteristics of microbial flora was investigated. Microörganisms isolated from the 3 seafoods immediately after radiation exposure at doses of 0.1 and 0.4 M rad did not show the same order of predominance found in the non-irradiated sample. The predominant bacterial species found before and after radiation exposure are listed. (C.H.)

9319 (CONF-651024, pp 31-3) RESEARCH STUDY CONCERNING THE MARKETING FEASIBILITY OF IRRADIATED FISHERY PRODUCTS. Morel, August (Bureau of Commercial Fisheries, Washington, D. C.).

Results are summarized from a market research study on the present status of the radiation pasteurization of fishery products in the U. S. Approximately 72% of the 609 producers, processors, wholesalers, distributors, brokers, and retailers interviewed were unfamiliar with the process and many said they had never heard of the process. Over 70% of all respondents gave the opinion that fresh fish sales will increase with improved product quality and prolonged shelf life but that the public will have to be educated to accept radiation processed food. (C.H.)

9320 (CONF-651024, pp 34-8) SUMMARY OF PROGRESS FOR 1965 [ON IRRADIATION OF FRUITS]. Maxie, E. C.; Sommer, N. F.; Guerrero, F. P. (California Univ., Davis).

Results are summarized from a series of studies on the effects of radiation processing on the ripening and extension of storage life of fruits. Data are included on bananas, prunes, strawberries, nectarines, peaches, oranges, and tomatoes, the effects of radiation on spores of Penicillium digitatum and Monilinia fructicola on fruits, and the effects of radiation on anthocyanin pigments of fruits. It was concluded that bananas, figs, strawberries, and tomatoes are ready for semicommercial test shipments using a mobile irradiator, and that nectarines and peaches need evaluation under semicommercial conditions with emphasis on package modifications to reduce mechanical injury to irradiated fruit. (C.H.)

9321 (CONF-651024, pp 39-42) EFFECTS OF LOW LEVEL IRRADIATION UPON THE PRESERVATION OF FOOD PRODUCTS. Dennison, R. A. (Florida Univ., Gainesville).

Results are reported from studies on the effects of 100 or 200 K rads γ radiation on the control of spoilage fungi and extension of the storage life of various varieties of peaches, strawberries, mangoes, tomatoes, lemons, oranges, tangerines, and limes. Strawberries and peaches showed favorable response to γ radiation. Citrus species and varieties varied greatly in their response. It was concluded that the physiological status of citrus fruits at the time of irradiation and post harvest storage conditions are possibly more critical than with many other fruit species. (C.H.)

9322 (CONF-651024, pp 43-8) DOSIMETRY, TOLERANCE, AND SHELF LIFE EXTENSION RELATED TO DISINFESTATION OF FRUITS AND VEGETABLES BY GAMMA IRRADIATION. Ross, Edward; Brewbaker, James L. (Hawaii Univ., Honolulu).

Results of a study of the effects of low dose γ radiation on the control of decay microörganisms, insect disinfestation, fruit ripening, and extension of refrigerated storage life of tropical fruits showed good results for papayas and mangoes. The studies encourage shipping and marketing tests of these fruits. Studies on pineapple and lychee fruits showed that radiation processing extended the shelf life of whole pineapple by 7 to 10 days but produced color and flavor changes in pureed pulp. No significant differences were found in the aroma, flavor, or texture of radiative processed lychee, but highly significant color changes were found in whole, unpeeled fruits treated with 25 to 200 K rad γ radiation and stored at 35°F for 4 to 5 weeks. Data are included on the effects of γ radiation on enzyme and pectin content of the fruits. (C.H.)

9323 (CONF-651024, pp 49-52) IRRADIATION OF INLAND FISH, FRUITS AND VEGETABLES. Markakis, P.; Nicholas, R. C.; Schweigert, B. S. (Michigan State Univ., East Lansing).

Results are summarized from a series of studies on the radiation processing of fruits and vegetables. A dose of 400 K rad γ radiation resulted in the highest water uptake of dry navy beans; 500 K rad γ radiation prevented the growth of mold and yeast in apple juice; 7.5 K rad γ radiation prevented sprouting of potatoes; dipping sweet cherries in a $CaCl_2$ solution before or after irradiation prevented radioinduced softening; 55 K rad γ radiation greatly reduced the number of viable spores of fungi on fresh strawberries and resulted in an extension of storage life, with best results obtained when irradiation was done on the day of harvesting; 400 K rad shortened the period of freeze-drying of prunes by about one third; and 10 K rad of γ radiation was found to reduce the activity of purified horseradish peroxidase by about 50%. Data are included on the radiosensitivity of spores of 6 fungi isolated from strawberries. (C.H.)

9324 (CONF-651024, pp 53-5) IRRADIATION STUDIES WITH INSECTS INFESTING BULK GRAIN AND PACKAGED COMMODITIES. [Marzke, F. O.] (Department of Agriculture, Savannah, Ga.).

Construction of a bulk grain and packaged commodity irradiator at Savannah, Georgia, is reported to be almost completed. Results are reported from preliminary studies on the radiosensitivity of insects infesting stored products. Insects were exposed to doses of 10, 20, 30, 50, or 100 K rad γ radiation during the egg, larva, pupa, and adult stage. The merchant grain beetle and the almond moth, Cadra cautella, were both found to be very radiosensitive. (C.H.)

9325 (CONF-651024, pp 67-9) HAWAII DEVELOPMENT IRRADIATOR (HDI). Garber, Harold J. (Nuclear Materials and Equipment Corp., Apollo, Pa.).

Progress is reported in the design and construction of a ^{60}Co irradiation system for irradiating tropical fruits in the Honolulu, Hawaii vicinity. (C.H.)

9326 (CONF-651024, pp 70-2) BULK GRAIN IRRADIATOR (BGI) AND MOBILE GAMMA IRRADIATOR (MGI). Lowenberg, H.; Morton, M. R. (Vitro Engineering Co., New York).

The design features are described of a bulk grain irradiator under construction at Savannah, Georgia. The facility has the capability of supplying a disinfestation dose of 25,000 rads ^{60}Co γ radiation at a grain flow rate of 5,000 lbs/hr, with a dose max/min ratio of less than 1.65. It also has a package handling capability for irradiating such packaged products as cake mixes, flour, and raisins. Design features are also described of a mobile γ irradiator capable of being transported by road from one harvesting area to another. It is designed to process 1,000 lbs/hr of a product, such as strawberries, at a radiopasteurization dose between 175,000 and 225,000 rads or it can process large quantities of a product, such as potatoes or onions, at a desprouting dose of between 5,000 and 15,000 rads. (C.H.)

9327 (CONF-651024, pp 73-7) THE SIGNIFICANCE OF CLOSTRIDIUM BOTULINUM TYPE E IN THE APPLICATION OF RADIATION-PASTEURIZATION PROCESS TO PACIFIC CRAB MEAT AND FLOUNDER. Eklund, M. W.; Poysky, F. T. (Bureau of Commercial Fisheries, Seattle, Wash.).

Data are presented from a survey on the incidence of Clostridium botulinum in Dungeness crab, crab processing plants, marine muds, trawl fish, and fish processing plants on the Pacific coast of the U.S. (C.H.)

9328 (CONF-651024, pp 78-80) EXAMINATION OF GAMMA IRRADIATED GULF SHRIMP AND OYSTERS FOR CLOSTRIDIUM BOTULINUM AND TYPE E TOXIN. Grodner, Robert M. (Louisiana State Univ., Baton Rouge. Dept. of Food Science and Technology).

Examination of shrimp and oysters from the Gulf of Mexico indicated an absence of Clostridium botulinum and Salmonella sp. and acceptable counts for E. coli and other Coliforms. Results are included from a study of toxin production by Clostridium botulinum Type E spores inoculated into γ irradiated fresh shrimp. No toxin was produced in inoculated shrimp exposed to γ radiation doses ranging from 0.15 to 0.5 M rads and stored at 33 to 34°F for 14 days before testing for toxicity in mice. (C.H.)

9329 (CONF-651024, pp 81-4) PHYSIOLOGICAL STUDIES ON CLOSTRIDIUM BOTULINUM, TYPE F. Walls, N. W. (Georgia Inst. of Tech., Atlanta. Engineering Experiment Station).

Results are summarized from a study of the physiology of Clostridium botulinum Type F. Data are included on the effects of temperature on growth and toxin production and the effects of γ radiation on the development of spores when irradiated in different media. (C.H.)

9330 (CONF-651024, pp 85-7) THE DETERMINATION OF THE WHOLESOMENESS OF IRRADIATION PASTEURIZED CLAMS. Reber, Elwood F. (Massachusetts Univ., Amherst. Dept. of Food and Nutrition).

Results are reported from a study of the effects of γ radiation on the protein efficiency ratio of clams and shrimp. Preliminary results of long-term feeding experiments showed that the inclusion of radiation processed clams as 35% solids in the diet of rats had no effect on food consumption or weight gain. (C.H.)

9331 (CONF-651024, pp 88-92) RADIATION OF HEME PROTEINS. Brown, W. D. (California Univ., Berkeley).

The nitrosyl derivative of myoglobin is common in various cured meats and the ferro- and ferrihemochromes are found in cooked meats and fish. Results are reported from a study of the binding ability of irradiated myoglobin. Results are included from studies on the relative sensitivities to denaturation by various agents of irradiated and non-irradiated myoglobins and the relative reactivity of irradiated and non-irradiated myoglobins with malonaldehyde. Results of studies indicate that malonaldehyde in irradiated amino acids is derived from some trace amount of contaminant substance and not from the breakdown of amino acids. It was concluded that the changes induced in myoglobins following irradiation are due to slight alterations in molecular shape and size, and that while the net effect may be slight, it may have significant effects on the properties that are important in irradiated foods. (C.H.)

9332 (CONF-651024, pp 93-4) CHRONIC ANIMAL FEEDING STUDIES ON RADIATION-PASTEURIZED CLAMS. Gabriel, Karl L. (AME Associates, Princeton, N. J.).

Fresh shucked clams, packed in polyethylene bags in tins, were irradiated at 400,000 or 800,000 rads and placed in cooler storage at 33° to 35°F for 30 days after which they were removed and blast frozen. The frozen clams were ground, steamed for one hour at 120°C, and dried to 50% dry weight in an oven. Preliminary 28-day feeding studies in chickens and dogs indicated no ill effects from diets containing 35% dry weight of the clams. (C.H.)

9333 (CONF-651024, pp 95-8) SHORT TERM SUBACUTE ANIMAL FEEDING STUDIES ON RADIATION-PASTEURIZED FOODS. Gabriel, Karl L. (AME Associates, Princeton, N. J.).

Short-term animal feeding studies in dogs and rats showed no ill effects from including radiation processed sweet cherries, plums, and apricots as 35% dry weight of the diet. Histologic examination of rat tissues showed mineral depositions in the kidneys. The cause was uncertain but it was concluded it was partially related to the high fruit content of the diets. (C.H.)

9334 (CONF-651024, pp 99-100) BASIC RESEARCH IN THE CHEMISTRY OF FISH. Ronsivalli, Louis J. (Bureau of Commercial Fisheries, Gloucester, Mass. Technological Lab.).

Results are summarized from studies on the chemistry of flavor and odor in irradiated fish. Emphasis was placed on the development of methods for collecting, separating, and identifying the volatile compounds in irradiated and non-irradiated fish. A number of carbonyl compounds in clam meats were detected and identified using the Girard-T reagent and gas chromatography. The relation of oxygen availability and reaction rates on the development of carbonyl compounds during irradiation at 4.5 megarads at cryogenic temperatures was investigated in vacuum-packed clam meats. Results of a taste panel test indicated that no off odors or flavors were detected in samples irradiated at cryogenic temperatures and served deep-fat-fried but samples served steamed were of much lower acceptability. (C.H.)

9335 (CONF-651024, pp 101-2) THE RADIATION PHYSIOLOGY AND MICROBIOLOGY OF FRUIT DETERIORATION. Sommer, N. F.; Maxie, E. C.; Buckley, Patricia M. (California Univ., Davis).

Results are summarized from a series of studies on the effects of radiation processing on the physiology of fruits and fungi causing deterioration in stored fruits. Gamma radiation was found to inhibit ripening of bananas, pears, and papayas by decreasing the sensitivity of the fruits to the ripening action of ethylene. The sensitivity of peaches and nectarines to ethylene was not inhibited by irradiation. Evidence was obtained for both nonenzymatic and enzymatic mechanisms for the production of ethylene in irradiated lemon fruits. Studies on the radiosensitivity, heat sensitivity, and cytology of certain fungi are reported. Emphasis was placed on Rhizopus stolonifer and Botrytis cinerea and the fungicidal value of radiation. (C.H.)

9336 (CONF-651024, pp 103-6) BIOCHEMISTRY AND PHYSIOLOGY OF IRRADIATED FRUITS AND VEGETABLES. [Massey, L. M. Jr.] (New York State Agricultural Experiment Station, Geneva).

Results are reported from studies of the biochemistry and physiology of irradiated fruits and vegetables. Kilorad doses of radiation stimulated the overall respiratory activity of most fruits and vegetables studied. Data are included from a study of the effects of kilorad doses of γ radiation on the intermediary metabolism of carrot tissues. Radiation had little effect on the metabolic utilization of glucose or pyruvate but did affect acetate metabolism, lipid synthesis, and amino acid synthesis. The texture of carrots was also affected by radiation and studies indicated that these changes were related to changes in the structural polysaccharides of the plant tissues. (C.H.)

9337 (CONF-651024, pp 107-10) THE EFFECT OF GAMMA RAYS ON HADDOCK AND CLAMS INOCULATED WITH CLOSTRIDIUM BOTULINUM, TYPE E. Nickerson, John T. R. (Massachusetts Inst. of Tech., Cambridge).

Results are reported from studies on the effects of doses of 150, 250, or 350 K rad γ radiation on toxin development in haddock fillets inoculated with spores of Clostridium botulinum Type E before irradiation and held at 33, 35, 40, and 45°F for up to three times the expected storage life. No outgrowth of bacteria or toxin production was observed in the irradiated samples. Untreated haddock fillets produced positive cultures and toxin production as revealed by tests in mice. The temperatures attained during deep fat frying of haddock destroyed approximately 21 to 5000 LD_{50} mouse units of toxin. It was found that Cl. botulinum Type E toxin in fish press juice is much less stable to

heat at pH 8.0 than at pH 6.0 and that the presence of Ps. fluorescens and Ps. fragi stimulated outgrowth and toxin production in aerobic cultures of Cl. botulinum, Type E. (C.H.)

9338 (CONF-651024, pp 111-14) IRRADIATION PASTEURIZATION OF SEAFOODS. Dollar, Alexander M.; Liston, J. (Washington Univ., Seattle. Coll. of Fisheries).

Results are reported from studies on the outgrowth of microörganisms of public health significance on seafoods, the effects of low doses of radiation and subsequent storage on the numbers and types of bacteria on fish, and the effects of radiation on the physiology of bacteria on fish. Emphasis was placed on the effects of radiation processing on the growth of Staphylococci and Pseudomonas. Studies on oysters indicated no effect of low level radiation on endogenous biochemical events post mortem. Differences between untreated and irradiated oysters were attributed to bacteriological effects. Studies on the flavor of radiation processed fish confirmed the importance of irradiation in vacuum, rather than air or nitrogen, for the prevention of flavor changes induced by radiation. (C.H.)

9339 (CONF-651024, pp 115-16) RADIATION BIOCHEMISTRY OF FRUIT. Romani, Roger J. (California Univ., Davis. Dept. of Pomology).

Since many of the critical effects of ionizing radiation in fruit tissues are fundamentally changes that occur in single cells, a study was made of the radiation biochemistry of fruit. Data are presented from studies on the effects of radiation on the size, density, and enzymic character of mitochondrial fractions; the effects of radiation on the activity of cytochrome oxidase, catalase, and acid phosphatase in fruit tissues; and the oxidative activity of mitochondria isolated from fruit exposed to 250 K rad radiation. (C.H.)

9340 (CONF-651024, pp 117-23) GROWTH CHARACTERISTICS OF TYPE E CLOSTRIDIUM BOTULINUM IN THE TEMPERATURE RANGE OF 34 TO 50F. (Continental Can Co., Inc., Chicago, Ill.).

Results are reported from a bacteriological study on the joint effects of low dose irradiation and permissible chemical food additives on the outgrowth of spores of Clostridium botulinum Type E in the temperature range of 34 to 50°F. Sodium benzoate, sodium p-hydroxybenzoate and sodium nitrite enhanced the effects of 0.322 M rad radiation on the retardation of spore outgrowth and Na_2 EDTA gave only a moderate extension of outgrowth time. Data are included from a study on the effects of temperature on the radiosensitivity of Type E spores in haddock homogenate and in neutral phosphate buffer. (C.H.)

9341 (CONF-651024, pp 124-30) STUDY OF CLOSTRIDIUM BOTULINUM TYPE E. Ward, B. Q.; Carroll, B. J.; Garrett, E. S. (Bureau of Commercial Fisheries, Pascagoula, Miss. Technological Lab.).

Preliminary results are presented from a survey of fish and shrimp from the Gulf of Mexico for incidence of Clostridium botulinum Type E. (C.H.)

9342 (CONF-651024, pp 133-5) STABILITY OF FOOD LIPIDS TO IONIZING RADIATION. Nawar, W. W. (Massachusetts Univ., Amherst).

The effects of γ radiation on the stability of food lipids were studied. Data are presented on radioinduced volatile compounds in fish oil. Gas chromatographic analysis of the irradiated oil revealed at least 42 compounds that were not present in non-irradiated controls. Among these compounds, a number of alkanes, alkanals, and acids were tentatively identified. The irradiated oils had a slightly smoked odor that became more obvious after storage for one week at 6°C. (C.H.)

9343 (CONF-651024, pp 136-7) 90-DAY SUBACUTE ORAL TOXICITY STUDIES ON RADIATION-PASTEURIZED FOODS (STRAWBERRIES, APPLES AND PEARS). Calandra, J. C.; Ives, Margaret (Industrial Bio-Test Labs., Inc., Northbrook, Ill.).

The results of 90 days of feeding a series of low-dose γ irradiated apples, pears, and strawberries to dogs and rats at dietary levels of 35% dry weight revealed no adverse effects on 10 parameters investigated. (C.H.)

9344 (CONF-651024, pp 138-54) SUMMARIES OF GENERAL SESSIONS AND SUBCOMMITTEE REPORTS. (Division of Isotopes Development (AEC), Washington, D. C. Division of Biology and Medicine (AEC), Washington, D. C.).

Developments in the radiation processing of fruits and vegetables in 1965 are reviewed. (C.H.)

9345 (CONF-651024, pp 155-201) AEC PROGRAM SCOPES OF WORK. (Division of Isotopes Development (AEC), Washington, D. C. Division of Biology and Medicine (AEC), Washington, D. C.).

The scope of research studies sponsored by the AEC in 1965 on the radiation processing of foods is reviewed. (C.H.)

9346 (TID-22289) EFFECT OF IRRADIATION ON THE MICROBIAL FLORA SURVIVING IRRADIATION PASTEURIZATION OF SEAFOODS. Sinnhuber, R. O.; Lee, J. S. (Oregon State Univ., Corvallis. Dept. of Food Science and Tech.). Apr. 26, 1965. Contract AT(04-3)-502. 70p. Dep. mn; CFSTI $3.00 cy, $0.50 mn.

Studies on analysis of microbial flora in irradiated dover sole, mutagenic probability of radiation, and combined effects of radiation and chemical additives are reported. Microbial spoilage of non-irradiated dover sole fillets stored at 43°F was found to be due to the growth of Pseudomonas. After irradiation at 0.1, 0.2, 0.3, and 0.4 Mrad, the spoilage flora became dominated by Achromobacter during 43°F storage. The growth of yeasts became exceedingly important among samples irradiated at 0.3, 0.4, and 0.5 Mrad; spoilage at 0.5 Mrad was entirely due to yeasts. The probability that radiation may produce harmful mutants was found to be limited. Four commonly used food additives, sodium benzoate, potassium sorbate, and the sodium derivatives of methyl and propyl esters of p-hydroxybenzoic acids, increased the 43°F storage-life of irradiated dover sole. The length of extended storage-life was approximately double that of the irradiated controls. (P.C.H.)

9347 GAMETOGENESIS AND RADIATION EFFECTS IN THE CEREAL LEAF BEETLE, OULEMA MELANOPA. Hoopingarner, R. A.; Kumararaj, S.; French, A. L. (Michigan State Univ., East Lansing). Ann. Entomol. Soc. Amer., 58: 777-81(Nov. 1965).

The cereal leaf beetle is an important pest of small grains, and the necessity of eradication is indicated after recognition of its infestation in Michigan. The early, circumscribed infestation area there suggested the use of the irradiated sterile-male release method. Thus, a study was undertaken of the normal gametic development and also of the effects of x rays upon reproductive tissues and egg viability. Gametogenic development was followed, using histological sections, from emergence of the adult through diapause and oviposition. Some spermatozoa were mature at emergence, and the testes had mainly mature sperm upon entering diapause. Oocyte development did not begin until the subsequent spring after mating took place. Doses as low as 500 R of x rays reduced egg production and viability. Complete loss of egg viability occurred when both sexes were irradiated with 5000 R. Loss of egg production occurred with doses above 5000 R. Spermatozoa were situated within the spermathecae up to and including doses of 20,000 R to both sexes. Thus, the male germinal cells are much more sensitive to radiation than the oocytes. The present inability to distinguish the sexes in living beetles causes reservations concerning the use of ionizing radiation for sterile-release methods, and the premature mortality resulting from doses necessary for sterility in males indicates difficulties with using ionizing radiation for sterile-male release programs. (BBB)

9348 MEASUREMENT OF THE DENSITY OF THE WATER-VAPOR EMULSION FLOWING IN BAFFLE TUBES

OF INDUSTRIAL BOILERS BY AN ENTRAINED RADIOISOTOPE METHOD. Maille, Claude (Societe Stein et Roubaix, Paris); Blanc, Daniel; Cohen, Henri; Maurel, Bernard. Bull. Inform. A.T.E.N. (Ass. Tech. Energ. Nucl.), No 55 Suppl., 10-11(Sept.-Oct. 1965). (In French).

A method for measuring the density of the water-vapor emulsion in baffle tubes of industrial boilers was developed using an entrained radioisotope. This procedure, applicable to a boiler in continuous operation, has the advantage of not disturbing its operation. A γ emitter integrated into a non-volatile compound is introduced in the water. During the vaporization, the quantity of the radioisotope in the emulsion decreases. Thus, by means of a detector measuring the activity of the water before vaporization and after formation of the emulsion, the specific weight of the emulsion can be calculated. The difficulties encountered in the utilization of the method are discussed and some measurements made on a small diameter boiler are reported. (J.S.R.)

9349 THE EFFECT OF IONIZING RADIATION UPON THE DEVELOPMENT OF THE MALLOW MOTH. Vasilyan, V. V. Entomol. Rev. (USSR)(English Transl.), 39: 425-8 (Jan.-Mar. 1961).

Effects of x rays on the mallow moth Pectinophora malevella, the larva of which feeds on cotton plants and is an economic pest, was investigated. Irradiation of raw cotton being shipped to uninfested areas was considered as a means of preventing spread of this insect. Caterpillars were irradiated with 1000- to 15,000-R doses of 180-kv x rays. A dose of 1000 R apparently had no effect on the development of the caterpillars, since the emerged moths were normal and had an almost identical egg production. Starting with a dose of 5000 R, x rays had a deleterious action. Thus, of the 80 caterpillars irradiated with doses of 5000 R only one of the moths that emerged was apparently normal, while the rest were malformed. These malformed moths died 1 to 3 days after emergence and did not oviposit. Thus, when wintering caterpillars were irradiated in their cocoons at the beginning of May, doses of 5000 R and higher were lethal to the moths that emerged while doses of 10,000 R and higher killed the caterpillars before they could leave the cocoons. In contrast, last-stage caterpillars of the summer generation were found to be relatively resistant to x rays. Doses of 5000 R and higher sharply decreased the fecundity of the moths or rendered them completely sterile. Doses of 10,000 R and higher were lethal for the caterpillars. In irradiation experiments with summer generation caterpillars feeding on cotton, up to 15% went into diapause. A dose of 1000 R had almost no effect on the development of the mallow moth. No difference was noted between the effects of irradiation of last-stage caterpillars and summer generation pupae. The doses used had no apparent effect on the longevity of the moths. (BBB)

9350 A ^{85}Kr BETA-RAY SOURCE FOR THE IRRADIATION OF LIQUIDS IN FLOW SYSTEMS. Hawke, J. G.; Brown, W. G. (Univ. of Chicago). Int. J. Appl. Radiat. Isotop., 16: 717-20(Dec. 1965).

Experiments are described, which relate to the use of ^{85}Kr gas, contained in a thin-walled glass bulb, as a β source for the irradiation of liquid materials contained in an annular space surrounding the bulb. A pilot model, charged with 300 mC of ^{85}Kr was operated successfully over a period of 15 months. (auth)

9351 EFFECT OF IONIZING RADIATIONS IN THE EGG. Gonzalez Varela, Manuel (Univ., Madrid). Rev. Univ. Madrid, 12: 1058-9(1963). (In Spanish).

The use of ionizing radiations in methods of preservation of foodstuffs is considered. Preliminary work demonstrated the usefulness of ionizing irradiation to prolong the commerical life of eggs. It has been possible to obtain a product which remains completely clear, intact, and has extended storage time without contamination by microörganisms, especially fungi. The doses which were used (about 100,000 rad) are those suitable for commercial pasteurization without causing degradation with off-color and -odor of the product. The radiopasteurized eggs were shown to retain good culinary qualities, such as ability to be beaten to a froth for use in pastry. Irradiation combined with spraying eggs with oil and low-temperature storage offered the best conditions for preservation. (BBB)

9352 STUDIES ON THE EFFECT OF MEDIUM DOSES OF GAMMA RADIATION ON THE ANTHOCYANIN PIGMENTS OF SOME FRUITS. III. THE USE OF SOME POTENTIAL PROTECTIVE AGENTS FOR ANTHOCYANIN PIGMENTS IN IRRADIATION. Horubala, Adolf (Agricultural Univ., Warsaw). Rocz. Technol. Chem. Zywnosci, 10: 131-44(1964). (In Polish).

Anthocyanin pigments were extracted from strawberries, raspberries, black and red currants, blueberries, and sour cherries by previously described methods. Their solutions were γ irradiated with ^{60}Co at a dose rate of 3×10^5 R/hr to total doses of 150, 250, 350, 500, and 700 krad at 5–8°C, alone and in the presence of various agents known to affect radiosensitivity. Changes in optical density of the anthocyanin solutions between 220 to 520 mμ were measured. Results of these experiments indicated that replacement of air atmosphere by N_2 or CO_2 did not have any protective effects on the anthocyanins in berries and their juices irradiated with 150 to 700 krad doses. The addition of 12.5–50 mg% SO_2 to the juices resulted in some protection of anthocyanins during irradiation as well as following storage. After its addition, the rate of destruction of ascorbic acid was higher than that of anthocyanins and it did not lower the rate of anthocyanin destruction. The molar rate of destruction of ascorbic acid in buffer solution is about tenfold higher than for anthocyanin pigments. This indicates that this natural antioxidant is not of value in preventing the color changes in fruits and their juices which result after pasteurizing doses of radiation have been used. (BBB)

9353 THE PRODUCTION AND TECHNICAL APPLICATIONS OF X-RAYS GENERATED IN THE RADIOACTIVE SOURCES. Florkowski, Tadeusz (Akademia Gorniczo-Hutnicza, Krakow). Zesz. Nauk. Akad. Gorn.-Hutn. Krakowie, No. 93, Rozpr., No. 32, 1-118(1964). (In Polish).

The physical principles of x-ray generation using beta particles are described, particularly the emission yield and x-ray spectra for various source constructions. X-ray detection using proportional, scintillation, and GM counters is discussed together with the edge filters method for separating characteristic lines. The theoretical principles and industrial applications of radioisotopic x-ray sources are then considered. The use of x-ray sources in thickness measurements is described. A new method of calculating shielding for bremsstrahlung sources is presented, and the possibility of a portable field instrument for the fluorescence analysis of ores is discussed. (L.B.S.)

9354 THE USE OF X-RAY FLUORESCENCE FOR THE AUTOMATION OF MAIL SORTING. Robin, G.; Daringny, E. (Societe l'Atome Industriel, Paris). Vienna, International Atomic Energy Agency, 1965, Preprint No. SM-68/9, 19p. (In French). (CONF-651023-16). ORINS.

From Symposium on Radioisotope Instruments in Industry and Geophysics, Warsaw.

The first operation in automated mail sorting is based on detecting the position of the stamp. By adding a specific mineral component to the stamp paper pulp labeling can be attained that is unaffected by external agents and can be detected by x-ray fluorescence. Zinc, which is normally not present in paper, can be incorporated in the stamp in the form of colorless oxide or sulfide. Excitation is induced by means of a ^{147}Pm-aluminum bremsstrahlung source. The fluorescent radiation (zinc K x-ray 8.6 kev) is detected by a proportional counter whose pulses are sorted by a single-channel pulse-height analyzer. In the band chosen, the signal-to-noise ratio is of the order of 8. The number and geometry of the sources were determined in such a way as to keep the frequency of errors to a mini-

mum. The choice of a large-window proportional counter made it possible to obtain a count rate large enough to reduce the statistical variation to a low value. In practice, the probability of stamp detection within an area of 60 × 40 mm is better than 99% and the probability of error due to incorrect detection is less than 10^{-4}. The letters can move at a rate of more than 360 m/sec, which represents a sorting rate of 40,000 letters per hour. A laboratory prototype was built and the results obtained showed that the process can be applied industrially. (auth)

9355 A METHOD FOR MEASURING THE ASH CONTENT IN COAL BY THE SCATTERED β-RAYS. Mori, Hisashi (to Yawata Iron and Steel Co., Ltd.). Japanese Patent 1964-16050. Aug. 7, 1964. Filed Sept. 5, 1960.

In a method for measuring the ash content in coal by the scattered β rays the coal powdered to less than 30 mesh is exposed to the parallel neutron beam from a collimator. Only the beta rays scattered from the coal, having the scattering angles from 100 to 180°, are detected by a radiation detector with a collimator. The detector output, i.e., the intensity of the scattered β rays, is read on the scaler or rate meter. (NSA of Japan)

9356 NEW STERILIZATION METHOD. Namiki, Mitsuo (to Inst. Phys. and Chem. Res.). Japanese Patent 1964-23893. Oct. 26, 1964. Filed Dec. 20, 1961.

A method for sterilization by ionizing radiation employs a chemical substance together with the ionizing radiation to improve the sterilizing effect. The chemical substances used are aliphatic alcohol halogenides such as chloral and aromatic halogenides such as halogen phenols and halogen naphthols. The sterilization is done by either of the following procedures: the object is irradiated in the presence of the above compound; the solution of the compound is first irradiated, then added to the object; the object is irradiated, then either the irradiated or non-irradiated compound is added. (NSA of Japan)

Power Application

See also ENGINEERING — Space Propulsion

Refer also to abstract 9695.

9357 (NAA-SR-Memo-10913) HISTORY ANALYSIS PROGRAM FOR FSM-4, FS-3, AND FLAP-4. Mikell, R. J.; Chang, G. T. (Atomics International, Canoga Park, Calif.). Sept. 1965. Contract AT(11-1)-Gen-8. 53p. Dep. mn. CFSTI $3.00 cy, $0.50 mn.

The History Analysis Program, developed for the analysis of data recorded on magnetic tape by the SNAP daily programs which process data acquired from the three systems FSM-4, FS-3, and FLAP-4 on a daily basis, is described. (D.C.W.)

9358 (ORNL-3826) ISOPOWER—COMPUTER PROGRAM FOR CALCULATING POWER OUTPUT OF SINGLE RADIOISOTOPE OR MIXED RADIONUCLIDE POWER SOURCES. Friend, Charles W.; Knight, J. R. (Oak Ridge National Lab., Tenn.). Dec. 1965. Contract W-7405-eng-26. 27p. Dep. mn. CFSTI $2.00 cy; $0.50 mn.

The computer program ISOPOWER calculates the power output of radioisotopes in watts per gram, watts per cubic centimeter, and curies per gram of source. The program sums the contributions to the total power output from all nuclides in a decay chain and from different chains of a mixed radionuclide power source. The results are printed and can be graphed as power output vs time curves on an associated plotter. The program is described, a sample problem is given, and the FORTRAN II calling program listed. (auth)

9359 SUBTERRANEAN NUCLEAR EXPLOSIONS AND RADIERGOLIC SPACE PROPULSION. Barre, J. J. Tech. Sci. Aeron. Spatiales, No. 4, 303-13(July-Aug. 1964). (In French).

Various radioisotopes are considered as heat sources for space propulsion. The alpha emitter ^{210}Po is unsuitable because of low surface power in thin layers, the poor penetration of alpha particles, and high density. Beta thermal propulsion is more feasible; several isotopes and combinations of isotopes are examined. An engine using α, β, and γ radiation from a mixed fission-product source encased in W is considered to be shielded from γ radiation and sufficiently refractory; a table of the approximate composition of such a source is given. (TCO)

9360 A NEW AND IMPROVED METHOD OF GENERATING ELECTRICITY. (to Yardney International Corp.). British Patent 1,010,479. Nov. 17, 1965. Priority date July 12, 1961, United States.

A method is described for generating electricity in which a pair of electrodes are placed in a liquid electrolyte, a radioactive material is used to establish a higher radiation level in one electrode than the other to generate an emf between the electrodes, and the electrodes are connected to an external circuit. The electrodes may be placed in a stream of water containing radioactive material, or the radioactive material may be placed in a container that constitutes one of the electrodes and the filled container placed in a stream of water. In either case, the electrode having the lower radiation level must be protected. Radioactive wastes may be used to generate electricity by this method. (B.L.M.)

Separation and Production

See also CHEMISTRY — Separation Processes and Procedures

9361 (NYO-755-2) SEPARATION OF ISOTOPES. Annual Progress Report. (Columbia Univ., New York. Dept. of Chemistry). Sept. 1, 1965. Contract AT(30-1)-755. 114p. Dep. mn; CFSTI $4.00 cy, $0.75 mn.

Separate abstracts were prepared for four of the seven sections in the report. The sections for which no abstracts were prepared are concerned with separation of deuterium from hydrogen by exchange, isotope effects among nitrogen oxides, and gas chromatographic separation of isotopes. (J.R.D.)

For abstracts of individual papers see: 9362—9365.

9362 (NYO-755-2, Paper 1) SEPARATION OF ISOTOPES: INTRODUCTION AND SUMMARY. Taylor, T. I. (Columbia Univ., New York. Dept. of Chemistry). 8p.

Results of studies concerning isotope exchange reactions for concentration of deuterium, ^{15}N, ^{18}O, and ^{13}C are reported. Emphasis was placed on dual-temperature systems for deuterium concentration, exchange reactions of nitrogen oxides for concentration of ^{15}N, and exchange of CO_2 with amine carbonates in non-aqueous solutions for ^{13}C and ^{18}O concentration. (J.R.D.)

9363 (NYO-755-2, Paper 3) MECHANISM OF THE CHEMICAL EXCHANGE OF ^{15}N BETWEEN NO AND HNO_3 FROM EXPERIMENTS IN AN EXCHANGE COLUMN. Garbazevich, J.; Taylor, T. I. (Columbia Univ., New York. Dept. of Chemistry). 41p.

Results of studies concerning ^{15}N exchange between NO and HNO_3 are summarized. Experiments to determine the effects of adding $NaHSO_4$, Na_2SO_4, $NaNO_3$, $NaClO_4$, and H_2SO_4 to liquid-phase 6M HNO_3 are described along with isothermal and adiabatic operation of exchange columns at about 25°C for 10M HNO_3. Adiabatic operation with 10M HNO_3 was found to result in higher overall separation than by isothermal operation. Results of additional experiments indicate that the reactions can be retarded or accelerated. (J.R.D.)

9364 (NYO-755-2, Paper 4) ENRICHMENT OF ^{18}O AND ^{13}C BY THE EXCHANGE OF CARBON DIOXIDE WITH AMINE CARBAMATES IN A SOLVENT-CARRIER SYSTEM. Agrawal, J. P.; Taylor, T. I. (Columbia Univ., New York. Dept. of Chemistry). 38p.

Separation of ^{18}O and ^{13}C by CO_2 exchange with carbamates of primary and secondary butylamines is reported. Efforts were made to hold parameters such as flow rate, concentration, and presence of catalysts constant to determine whether or not correlations can be established between amine characteristics and the magnitude of the overall isotope separation. (J.R.D.)

9365 (NYO-755-2, Paper 6) PREPARATION OF HIGHLY ENRICHED ^{15}N USING THE OXIDES OF NITROGEN WITH A CARRIER SOLVENT. Jeevanandam, M.; Taylor, T. I. (Columbia Univ., New York. Dept. of Chemistry). 8p.

Investigations are described in which the effects of carrier solvents on the characteristics of $NO-N_2O_3$ exchange systems are evaluated. Plant requirements for production of 1 g/day of 99 at. % ^{15}N were calculated. To test these estimates and examine the feasibility of solvent carrier systems for production of highly enriched ^{15}N, a cascade of tapered glass columns was operated. Operation and performance of the cascade is summarized. (J.R.D.)

9366 ARGONNE RESEARCH ELECTROMAGNETIC ISOTOPE SEPARATOR. Lerner, Jerome L. (Argonne National Lab., Ill.). Argonne Nat. Lab. Rev., 2: 79-83 (Oct. 1965).

The Argonne research electromagnetic isotope separator and its performance are described. Methods of collection of the separated isotopes are compared, and various applications of the AREMIS are discussed. (L.B.S.)

9367 STUDIES ON THE PRODUCTION OF HEAVY WATER. III. ANALYTICAL CONTROL OF THE PRODUCTION INSTALLATIONS. Otero de la Gandara, J. L.; Gispert Benach, M.; Rojas de Diego, J. L. (Junta de Energia Nuclear, Madrid). Energia Nucl. (Madrid), 9: 248-55(July-Aug. 1965). (In Spanish).

Two methods are used for analytical control in the installation for production of heavy water. These are the flotation method and the infrared spectrometric method at all concentrations. The principles and procedures for each method are described. (J.S.R.)

9368 RAPID DETERMINATION OF ^{18}O IN ENRICHED WATER BY A THERMISTORIZED VAPOR PRESSURE OSMOMETER. Lazzarini, E. (CESNEF, Milan). Energia Nucl. (Milan), 12: 639-41(Dec. 1965). (In Italian).

A method is described for the determination of ^{18}O concentration in enriched water using the vapor pressure osmometer "Mechrolab mod. 301A." The method gives good results in the whole examined range of concentration (from 0.57 to 5.82 atom percent in excess of the natural concentration). (auth)

9369 METHODS FOR PRODUCING DEUTERIUM BY DISTILLATION OF HYDROGEN. Stouls, Leon (to Commissariat a l'Energie Atomique). U. S. Patent 3,216,800. Nov. 9, 1965. Priority date May 2, 1960, France.

A method is described for producing deuterium by distillation of hydrogen in an apparatus that includes two elementary columns of relatively small diameter provided with packing or plates and a vaporizer-condenser between the two columns. A hydrogen mixture enriched in deuterium hydride is fed to the top portion of the upper column. A zone of enrichment in HD without enrichment in HT is provided in the middle portion of the upper column. A zone for the accumulation and withdrawal of liquid enriched in HT is provided in the bottom portion of the upper column, and the HD enriched liquid is withdrawn from the middle portion of the upper column. The temperature of the collected enriched liquid is raised; the liquid is catalytically transformed into a mixture (the same material fed into the top of the column) of H_2, D_2, DH, and T_2; and the mixture is compressed and cooled by heat interchange with the collected liquid. The tritium hydride present in the final distillation column is subjected to a catalytic reaction with D_2 from the column to form HD and DT. (B.L.M.)

MATHEMATICS AND COMPUTERS

Refer also to abstract 8536.

9370 (AAEC/TM–295) A LOGIC CARD SYSTEM. Ellis, P. J.; Klein, A. G. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Aug. 1965. 106p. Dep. mn.

A set of printed circuit modules designed for application in digital systems is described. The most commonly used switching and logic circuits together with pulse generators and shapers are available, and it is envisaged that system design and construction can be carried out using block diagrams of such modules exclusively. The conventions and graphic symbols are presented, together with brief explanations of the circuit functions covered. Complete data for each module are presented, including performance specifications, circuit diagrams, and component layouts. (auth)

9371 (IC/65/86) SOME REMARKS ON THE CONSTRUCTION OF INVARIANTS OF SEMI-SIMPLE LOCAL LIE GROUPS. Santhanam, T. S. (International Centre for Theoretical Physics, Trieste (Italy)). Dec. 2, 1965. 10p. Dep. mn.

A general form of the l invariants of compact semi-simple local Lie groups of rank l, as the traces of the powers of the velocity potential operator, is suggested. The connection of this form of the invariants with those of Gruber is described. The possible generalization beyond those of the adjoint group is discussed. (auth)

9372 (NP–15717) ASYMPTOTIC GROWTH CURVES WITH APPLICATIONS. Wilcoxson, W. L. (Naval Civil Engineering Lab., Port Hueneme, Calif.). Dec. 1965. 73p.

The fitting of experimental data to an empirical or semiempirical formula of nonlinear form is considered. Such problems, which involve asymptotic growth curves, are not amenable to solution by the usual linear least squares curve fitting techniques. Since nonlinear curve fitting problems have arisen in connection with various tasks, it appeared desirable to devise and adapt general mathematical methods for treating a class of nonlinear problems. Methods for performing nonlinear curve fits, together with a method for choosing the best of several possible empirical formulas are described. FORTRAN computer programs are provided, and applications are discussed. (auth)

9373 (UCRL–14541) EXPALS—FORTRAN CODE FOR EXPONENTIAL APPROXIMATION BY LEAST SQUARES. Gardner, C. Douglas (Lawrence Radiation Lab., Univ. of California, Livermore). Dec. 2, 1965. Contract W-7405-eng-48. 8p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

EXPALS is a weighted least-squares exponential FORTRAN code to be run under the MONITOR system of the IBM 7030 (Stretch) computer. This routine fits a linear combination of real exponential decay functions by the Prony-Householder iteration method. (auth)

9374 IRREDUCIBLE REPRESENTATIONS OF THE ROTATION GROUP IN TERMS OF EULER'S THEOREM. Moses, H. E. (Massachusetts Inst. of Tech., Lexington). Nuovo Cimento (10), 40A: 1120–38 (Dec. 21, 1965).

In previous discussions of the irreducible representations of the rotation group, the matrix elements corresponding to finite rotations were given in terms of the Euler angles of the rotation. Rotations are described by means of a vector θ where the direction of θ is the direction of the axis of rotation and $|\theta|$ is the angle of rotation. The matrix elements corresponding to the finite rotation given by θ are matrix elements of $\exp[i(\theta \cdot J)]$ where the matrices J_i $(i = 1,2,3)$ are the infinitesimal generators of the representation of the rotation group. The representation thus takes the form given by Stone's theorem for one-dimensional groups. The matrix elements corresponding to the finite rotations are expressed in closed form in terms of Jacobi polynomials. Aside from the mathematical elegance of the result, the representation is useful in showing how wave functions transform in a rotated frame of reference when the axis of rotation is prescribed. Although in principle the transformation properties of the wave function could be obtained in terms of the Euler angle parametrization, the expressions are extremely cumbersome for a general axis of rotation. In the present representation, on the other hand, the expressions are simple. As part of the proof the transformation from the basis in which J_3 is diagonal to that in which $\theta \cdot J$ is diagonal is also given. The matrix elements for finite rotation for the cases of spin $\frac{1}{2}$, 1, and $\frac{3}{2}$ are computed in the new representation. (auth)

METALS, CERAMICS, AND OTHER MATERIALS

General

Refer also to abstracts 10274 and 10354.

9375 (BNWL-166) METALLURGY RESEARCH SECTION. Quarterly Progress Report, July–September 1965. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Oct. 15, 1965. Contract AT(45-1)-1830. 82p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

Separate abstracts were prepared for the 13 sections of the report. (W.L.G.)

For abstracts of individual sections see: 9410–9412, 9487–9490, 9565–9569, and 10424.

9376 (CONF-650620) PROCEEDINGS OF SODIUM COMPONENTS DEVELOPMENT PROGRAM INFORMATION MEETING, CHICAGO, ILLINOIS, JUNE 16-17, 1965. (Chicago Operations Office (AEC), Ill.). 292p. Dep. mn; CFSTI $3.00 cy, $1.50 mn.

Separate abstracts were prepared for 17 of the 18 papers. One paper was previously abstracted in NSA, see 20: 2430. (W.L.G.)

For abstracts of individual papers see: 8825, 9377, 9413–9419, 9440, 9570, 10289, 10290, 10322, and 10367–10369.

9377 (CONF-650620, pp 85-104) FERMI MATERIALS EXPERIENCE. Shoudy, A. A. Jr.; Brown, B. P.; Kovac, L. R.; McHugh, W. E. (Atomic Power Development Associates, Inc., Detroit, Mich.).

The sodium purity and thermal history of the Fermi reactor, the carburization of stainless steel in the primary system, hydriding of zirconium cladding on the fuel pins, performance of oscillator rod bearings, boronated graphite irradiation studies, and experience with an antimony-beryllium neutron source are described. (W.L.G.)

9378 (GEMP-54A) HIGH-TEMPERATURE MATERIALS PROGRAM. Progress Report No. 54, Part A. (General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation). Dec. 20, 1965. Contract AT(40-1)-2847. 73p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

Creep-rupture testing of Mo–TZM alloy specimens was conducted at 1310°C. Results indicate only minor changes in these properties at this temperature for specimens irradiated to a fast neutron fluence of 6.8×10^{19} nvt. Hot-hardness measurements of W single crystals irradiated to three fast neutron fluence levels (4.6×10^{18}, 2.4×10^{19}, and 7.3×10^{19} nvt) were completed. Room-temperature hardness values following elevated temperature anneals of the specimen irradiated to 7.3×10^{19} nvt ($E_n \geq 1$ Mev) reached a maximum at a temperature of 800°C, an increase of approximately 31% compared to the as-irradiated specimen. A comparison of the microhardness increment fraction vs homologous test temperature curves for irradiated Mo and W show a much different defect recovery characteristic for W in the region of 0.12 to 0.35 T_m. This is partially attributed to the formation of irradiation-induced defect–foreign atom complexes with Re and Os atoms. Resistivity measurements on isothermally annealed irradiated Mo specimens were conducted in the temperature region of 0.31 T_m. Preliminary analysis of the data shows that probably more than one recovery process is occurring in this temperature range with activation energies in the range of 2.0 to 2.5 ev. Based on computer simulations, the collided atom volume produced by a cascade is multiply-connected but the region of anelastic strain produced by the associated displacement spike can be taken to be simply connected and its volume is about 3.5 times the collided atom volume at 0°K in α-Fe. The irradiation-produced increase in electrical resistivity is proportional to the cumulative collided atom volume. The electrical resistivity, therefore, saturates when the cumulative collided atom volume fills the specimens. Irradiation hardening, however, is greatest for a critical separation distance between dislocation barriers. If displacement spike anelastic strain regions are assumed to act as barriers to dislocation movement then irradiation hardening of a pure metal will be greatest when the displacement spike density is such that this critical separation distance is realized. This circumstance, the fact that the anelastic strain region volume exceeds the collided atom column, and the at-least three-fold-cascade-overlap condition, for electrical resistivity saturation, combine to give a smaller exposure for maximum hardening than for saturation of electrical resistivity in pure α-Fe at 0°K. The exposure for electrical resistivity saturation is predicted to be at least 10^2 times larger than that for maximum neutron-irradiation hardening in pure α-Fe at 0°K. Testing was conducted to demonstrate the capabilities of the new fatigue testing machine. The tests verified the ability to control the machine with the aid of an extensometer that monitors the diameter variation in a push-pull type specimen. The reduction in the creep-rupture life of Hastelloy N specimens tested at 650°C appears to be independent of the irradiation temperature; i.e., reactor ambient temperature or at 650°C Specimens of A-286 containing the least amount of B have the greatest reduction in creep-rupture properties for both reactor ambient and 650°C irradiations. Specimens of Fe–15Cr–4Al–1Y irradiated at reactor ambient temperature showed only minor changes in post-irradiation tensile properties at 650, 750, and 850°C when compared to control specimens tested at the same temperature. In particular, the ductility was not affected when tested at elevated temperatures for specimens irradiated to a fast neutron dose of 7×10^{19} nvt (fission). The relative resistance to microcracking was determined for several BeO compositions in measurements of the dimension and strength changes following irradiation at 100°C. A fine-grained material (8 μ) containing 1 wt % bentonite in UOX-grade BeO appeared somewhat more stable than materials of similar grain size examined previously while a composition containing 1 wt % Al_2O_3 in UOX-grade BeO appeared particularly susceptible to microcracking. Other compositions examined, including specimens from five production blocks of the EBOR material, exhibited microcracks at dosages of 1 to 2×10^{20} nvt ($E_n \geq 1$ Mev). The thermal diffusivity of an extensively microcracked specimen irradiated at 100°C was only about 10% of that of the unirradiated material at 300°C and varied only slowly with temperature. On annealing at 1000°C, the diffusivity recovered to about 90% of the unirradiated value; the lack of full recovery is attributed to uncured microcracks remaining after the annealing treatment. In contrast, the diffusivity of a specimen irradiated at 1000°C to 2.5×10^{21} nvt ($E_n \geq 1$ Mev) decreased by amounts ranging from 20% at 300°C to about 4% at 1000°C. Studies of Kr transport in Ta at elevated temperatures were continued. Optimum discharge conditions for simultaneously loading and diffusing measurable levels of ^{85}Kr into finegrained arc-cast Ta at 1830°C were established. Anodization and mechanical stripping of the resulting oxide layer were established as the sampling procedure for obtaining fission product distribution data at successive depths in a Ta can used to contain urania fuel during irradiation. Surfaces may be prepared for anodization by grinding and polishing at approximately 100-μ-depth intervals. Corrosion tests of Zircaloy in steam at 1200 to 1600°C show that tin or a tin-rich alloy is precipitated in the ZrO_{2-x} layer of the oxide film. In samples tested under isothermal conditions, this layer of tin is a well defined line near the metal-oxide film interface. In samples tested under transient thermal conditions the tin-rich alloy appeared as a network

structure in the oxide film. Type 304 stainless steel shows considerable bloating as the metal melts in stream after heating at a 0.3°C temperature rise per sec. This effect is not seen where the heating rate is 3°C per sec. U encapsulated in Fe–15Cr–4Al was tested for various times at temperatures in the range 600 to 1200°C. Interaction of the two materials varied from a trace of reaction at the interface after 750 hrs at 600°C to extensive compound formation and penetration of a 0.48-cm cladding in 80 hrs at 1200°C. (W.L.G.)

9379 (NAA-SR-11650, Sect. 4) REACTOR PHYSICS AND FUELS AND MATERIALS. (Atomics International, Canoga Park, Calif.). 46p.

Fission neutron age measurements were made in aluminum–water mixtures. The effect of the inelastic and elastic scattering anisotropy in aluminum and water on the neutron age and higher moments is given. Pulsed neutron diffusion length measurements were made for diphenyl and graphite. Further development on the cross section analysis and applications project is discussed. A series of UC single crystal, electron beam, zone refining studies in which the rotation rate and zone traverse rate were varied were made. Results from these studies are presented. The lattice effects of adding W to UC are discussed. An investigation of defect structures and radiation damage effects of refractory moderator materials is presented. The swelling resistance of several uranium alloys was investigated at high temperatures. (M.O.W.)

9380 (ORNL-P-1008) FLUIDIZED-BED CHARACTERISTICS IN THE COATING OF NUCLEAR FUEL PARTICLES. Pilloton, R. L.; Lotts, A. L. (Oak Ridge National Lab., Tenn.). [1964]. Contract W-7405-eng-26. 29p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Theoretical calculations were made of the flows of fluidizing and coating gases to be used for coating nuclear fuel particles. On that basis, equations and curves were established to demonstrate that the two gas flows should be programmed to achieve uniform fluidization and constant linear growth rate of the particles. The motion of fluidized-bed particles in glass columns was observed, and it was concluded that bubbling of the bed was a major parameter affecting particle motion, gas-solid contact, and column design. (auth)

9381 (TID–22507) RESEARCH ON GRAPHITE, Summary of Work, April 1, 1965–March 31, 1966. Walker, P. L. Jr.; Palmer, H. B.; Diethorn, W. S. (Pennsylvania State Univ., University Park). Dec. 10, 1965. Contract AT(30-1)-1710. 69p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

Progress in studies on carbon formation and graphitization, gas-graphite interactions, solid state studies, and mechanism of fission gas diffusion in graphite is summarized. (W.L.G.)

9382 URANIUM RESERVES AND FUEL ELEMENTS. REPORTS OF SECTIONS 1A AND 1B OF THE FORATOM CONGRESS. Beisswenger, H. (Kernforschungszentrum, Karlsruhe, Ger.). Atomwirtschaft, 10: 662-4(Dec. 1965). (In German).

No acute lack of nuclear fuel materials is expected; however, West Europe is dependent on imports so long as no improved fuel element utilization and breeding with plutonium is developed. Increases in the capacity of processing installations are considered. (tr-auth)

9383 ZIRCONIUM AND HAFNIUM. Eilertsen, Donald E. (Bureau of Mines, Washington, D. C.). Eng. Mining J., 166: 123-4(Feb. 1965).

The production, price, importation, exportation, and applications of Zr and Hf for 1964 are reviewed. Estimates for 1964 indicated larger domestic zircon output, smaller zircon imports and consumption, and smaller zirconium metal and hafnium oxide outputs compared with 1963. Domestic zircon containing 66% ZrO_2 was quoted at $47.25 per short ton. Hafnium sponge was quoted at $75 per lb while rolled bar and plate was quoted at $138 per lb. (BBB)

9384 COLUMBIUM AND TANTALUM MINERALS. Brackin, Robert. Eng. Mining J., 166: 124-5(Feb. 1965).

Demand for, prices, consumption, and applications of niobium and tantalum in 1964 are reviewed. Imports of niobium concentrates were 2600 tons, a 4% increase over the 1963 total. Total U.S. consumption of ferroniobium for the year is estimated at 2.6-million lb. Consumption of the metal and its alloys probably averages 50,000 lb per year. There was little change in demand for tantalum raw materials in 1964 compared to 1963. The price remained essentially the same as in 1963, $4 to $4.50 per lb of contained pentoxides for 60% Ta_2O_5 content and $3 to $3.50 per lb for 30% Ta_2O_5 content. Consumption of tantalum metal and alloys in 1964 is estimated at 300,000 to 400,000 lb. (auth)

9385 RARE EARTHS. Otis, W. A. Eng. Mining J., 166: 128-9(Feb. 1965).

Production, prices, and uses of rare earths in 1964 are reviewed. A large demand was created by the development of a europium-yttrium phosphor. The two main ores that are used as sources of rare earths are monazite and bastnasite. Leading basic producers of rare earth chemicals are enumerated. (BBB)

9386 THORIUM. Baroch, Charles T. (Bureau of Mines, Washington, D. C.). Eng. Mining J., 166: 132-4 (Feb. 1965).

Figures for the 1964 production, prices, demand, and future estimates of requirements for thorium are reviewed. Preliminary data indicate that 1964 domestic production remained small and imports aggregated about 1800 short tons of monazite, compared with 6434 tons in 1963. Value of imports dropped from $770,000 to about $155,000. The most important use for thorium metal was in magnesium alloys containing about 3% Th. Two power reactors are described that use Th. One was designed to deliver 40,000 kw. Its fuel consists of 484 lb of enriched uranium and 3190 lb of thorium, both in the carbide form. At the end of the year 848,354 lb of thorium residues were in the Defense Production Act stockpile. (BBB)

9387 URANIUM: CANADA'S FIVE YEAR PROGRAMME. Mining J., 264: 461-2(June 11, 1965).

Canada's uranium reserves are considered. At the end of 1964 Canada had only three operating mines, Rio Algom's Nordic mine, the Denison mine, and Eldorado's operation at Beaverlodge Lake. A five-year program for stockpiling uranium was announced in Canada. The price to be paid would be $4.90 per lb U_3O_8. (BBB)

9388 GROWTH AND PURIFICATION OF YTTRIUM MONOCRYSTALS. Mezentseva, N. L.; Mikhailova, N. P.; Starostina, L. S.; Dolomanov, L. A. (Inst. of Crystallography, Academy of Sciences, USSR). Fiz. Metal. Metalloved., 20: 474-5(Sept. 1965). (In Russian).

Tests were carried out to prepare large, pure single crystals of yttrium by zone melting in vacuum without using a crucible. The 80-mm-long rods subjected to zone melting yielded in their central portion 1-cm-long and 5-mm-diameter single crystals; the monocrystalline character of the specimens was established by x-ray diffraction. Chemical analysis revealed that the zone melting process reduced the Fe, Cu, and Ca content of the specimens by a factor of 27, 20, and 10, respectively. The oxygen content was reduced by a factor of only 2.4; this is probably due to the formation of stable oxides with a partition coefficient of close to 1. In order to further reduce the oxygen content, direct current was sent through the specimens; as a result of the action of a current with a density of 5 amp/mm^2, the oxygen content was found to be 3 times higher in the anode compartment than in the region of the cathode. (TTT)

9389 THE FORMATION OF LONGITUDINAL WRINKLES DURING CREEP COLLAPSE OF THIN STAINLESS STEEL FUEL ELEMENT CANS. Ward, K. D.; Stacey, R. D. (United Kingdom Atomic Energy Authority, Springfields, Eng.). J. Brit. Nucl. Energy Soc., 4: 354-8(Oct. 1965).

After confirming the validity of the classical elastic instability analysis of elastic deflections and instantaneous collapse pressure, the creep collapse of thin, ribbed, stainless steel cans around cylindrical fuel pellets was studied. It was found that a critical fuel-can clearance existed, above which longitudinal wrinkles formed in the can. The critical clearance increased as the external pressure decreased. An empirical theory which satisfactorily predicts the observed behavior is described. (auth)

9390 REVIEW OF SOLUBILITY DATA FOR THE LIQUID SODIUM–OXYGEN SYSTEM. Claxton, K. T. (Atomic Energy Research Establishment, Harwell, Eng.). J. Nucl. Energy: Pt. A and B, 19: 849-89(Nov. 1965). (AERE-R-4897).

A survey of data for the solubility of oxygen in liquid sodium is presented. The requirements of a solubility study are discussed, and methods of analysis for oxygen are considered. An equation is proposed for the correlation of the data. 50 references. (D.C.W.)

9391 AN APPROACH TO SCALE UP OF AN INTERMETALLIC COMPOSITE MATERIAL FOR STRUCTURAL APPLICATIONS. Anthony, F. M. (Bell Aerosystems Co., Buffalo). pp 36-54 of Symposium on Newer Structural Materials for Aerospace Vehicles. ASTM Special Technical Publication No. 379. Philadelphia, American Society for Testing and Materials, 1965.

Refractory nonmetallic materials are attractive for high-temperature structural applications, but in most instances the most promising materials have been produced only on a laboratory scale. One such material and the efforts to scale up the processing procedures to an extent where practical structural components can be produced is described. The point of view is that of the designer rather than that of the materials engineer. The material is a multiphase body formed from ZrB_2, $MoSi_2$, and B_4C powders by means of cold pressing and sintering. The scale-up program, while following essentially standard procedures, was established to give more direct attention to user requirements than is normally the case with material scale-up activities. Early consideration of microstructural and chemical gradients, inspection requirements, and surface finish characteristics resulted from a close cooperation of the user and the material supplier. Throughout the scale-up effort, emphasis is being placed on maintaining similarity of the material as produced for test bars and for components. In this way, the designer is provided with a maximum of confidence in the characteristics to be expected from the material used for structural hardware. Control of sintering conditions, configuration of green shapes to be sintered, and machining procedures were identified as items of major importance for maintaining similarity. Electron microprobe techniques, radiographic and ultrasonic inspection techniques, and metallographic examination at high magnification provided valuable information regarding the degree of similarity obtained. (auth)

9392 CARBIDES IN NUCLEAR ENERGY. Volume 1: Physical and Chemical Properties; Phase Diagrams. Proceedings of a Symposium held at Harwell, November 1963. Russell, L. E.; Bradbury, B. T.; Harrison, J. D. L.; Hedger, H. J.; Mardon, P. G. (eds.). London, Macmillan and Co., Ltd., 1964. 505p. (CONF-206-A).

Thirty-six papers were presented; separate abstracts have been prepared for thirty. For abstracts of papers previously included in NSA, see: 18: 203, 2222, 2223, 10537, 22484, and 31430. An abstract and discussion on the topic of the resistivity and thermoelectric power of Th, U, and Pu carbides are included. (W.L.G.)

For abstracts of individual papers see: 8872–8874, 8948, 9432–9438, and 9541–9559.

9393 CARBIDES IN NUCLEAR ENERGY. Volume 2: Preparation and Fabrication; Irradiation Behaviour. Proceedings of a Symposium held at Harwell, November 1963. Russell, L. E.; Bradbury, B. T.; Harrison, J. D. L.; Hedger, H. J.; Mardon, P. G. (eds.). London, Macmillan and Co., Ltd., 1964. 535p. (CONF-206-B).

Separate abstracts were prepared for the thirty papers included in the volume. (W.L.G.)

For abstracts of individual papers see: 9394–9401, 9456–9469, 9534–9536, and 9592–9596.

9394 THE PREPARATION OF CARBIDES BY REACTION HOT PRESSING OF OXIDES AND CARBON. Riley, B. (Atomic Energy Research Establishment, Harwell, Eng.). pp 485-95 of Carbides in Nuclear Energy. Vol. 2. Russell, L. E. (ed.). London, Macmillan and Co., Ltd., 1964.

The reaction hot pressing characteristics of UO_2-C, ThO_2-C, PuO_2-C and $(UPu)O_2-C$ mixtures were studied over the temperature range 1000-2000°C using pressures up to 3 tsi in a tungsten foil-lined graphite crucible. Using a two stage process, densities greater than 90% theoretical density can be achieved. (auth)

9395 PREPARATION AND CHEMICAL PROPERTIES OF URANIUM CARBIDES. Atoda, T. (Inst. of Physical and Chemical Research, Tokyo); Kobayashi, M.; Sasa, Y.; Takahashi, Y.; Higashi, I. pp 496-517 of Carbides in Nuclear Energy. Vol. 2. Russell, L. E. (ed.). London, Macmillan and Co., Ltd., 1964.

Investigations were made into the preparation of uranium carbides by the direct carbothermic reduction of U_3O_8, obtained by heating $UO_2(NO_3)_2 \cdot 6H_2O$ in air at 900°C, to obtain basic knowledge that will be useful in the development of commercial processes for the production of uranium carbides. Studies of the reactions between uranium carbides and air, oxygen, CO_2, and nitrogen, were also made. (auth)

9396 SOME ASPECTS OF THE PREPARATION OF URANIUM AND PLUTONIUM CARBIDES FROM OXIDES. Ainsley, R. (Atomic Energy Research Establishment, Harwell, Eng.); Wood, D. C.; Sowden, R. G. pp 540-9 of Carbides in Nuclear Energy. Vol. 2. Russell, L. E. (ed.). London, Macmillan and Co., Ltd., 1964.

Results are presented relating to the preparation of U–C and (UPu)–C by the reduction of oxides the C. Under certain conditions the presence of Pu can modify the mechanism of the reaction, $(UPu)O_2$ and $(UPu)_2C_3$ being formed as intermediates. Another feature of interest is the tendency of a Pu species to volatilize from (UPu)–C at high temperature. An upper limit for the vapor pressure is given by: $\log p\ (atm) = 5.47 - (23{,}000)/T°K$. (auth)

9397 THE USE OF FLUIDISED BEDS FOR PRODUCING CARBIDE etc. Fletcher, J. M. (Atomic Energy Research Establishment, Harwell, Eng.); Hyde, K. R.; Landsman, D. A. pp 550-5 of Carbides in Nuclear Energy. Vol. 2. Russell, L. E. (ed.). London, Macmillan and Co., Ltd., 1964.

Metal carbides can be conveniently prepared in fluidized beds from intimate mixtures of the metal oxides and C. The mixture, in the form of spheroids or granules, contained in a graphite reaction vessel, is fluidized with Ar. The graphite container acts as a susceptor for induction heating. The reaction was readily followed by gas chromatographic analysis of the effluent gas stream for CO. Carbides of U, Mo, V, and Zr were prepared in this manner at temperatures between 900 and 1600°C. A fluidized bed in a graphite vessel was also used for the preparation of other ceramic materials. Thus UN and zirconium boride were prepared from the corresponding metal oxides. (auth)

9398 THE PREPARATION OF U–C AND (UPu)–C BY THE REDUCTION OF OXIDE WITH CARBON IN FLOWING ARGON. Harrison, J. D. L. (Atomic Energy Research Establishment, Harwell, Eng.); Isaacs, J. W. pp 556-71 of Carbides in Nuclear Energy. Vol. 2. Russell, L. E. (ed.). London, Macmillan and Co., Ltd., 1964.

Compacted mixtures of oxide and C reacted smoothly at 1500–1600°C in flowing Ar. The effect of oxide/C ratio, reaction temperature, gas flow rate, mixing conditions, and type of C used, on the composition and sinterability of the product were assessed. C control to ±0.05 wt% and O_2 contents below 0.3 wt% were achieved. The product sintered to a bulk density >12.9 g/cm^3. (auth)

9399 THE PREPARATION OF Pu-, U- AND MIXED (Pu U)- CARBIDES BY THE METAL-HYDROCARBON GAS REACTION. Brown, F.; Dennard, F. S.; Ellis, P.; Good, P. T.; Lapage, Ruth (Atomic Weapons Research Establishment, Aldermaston, Eng.). pp 693-710 of Carbides in Nuclear Energy. Vol. 2. Russell, L. E. (ed.). London, Macmillan and Co., Ltd., 1964.

Pu- and U-carbide powders were prepared by the reaction of propane gas with the finely divided metals or metal hydrides. The reactions were studied in the temperature range 600–800°C using a thermobalance and the results illustrate the complexity of the reaction kinetics. The reaction products were Pu_2C_3 and UC respectively. Powders were pressed and sintered to give pellets of greater than 90% theoretical density. It was possible to produce pellets of single phase PuC by sintering powders containing Pu_2C_3 and PuH_2 with the correct overall Pu/C ratio. Work was extended to cover the reaction of a U–15% Pu alloy and present indications are that it behaves similarly to U. (auth)

9400 (UZr)C FOR THERMIONIC CONVERTERS. Adam, J. (Atomic Energy Research Establishment, Harwell, Eng.); Harrison, J. W.; Riviere, J. C.; Thorpe, T. pp 801-15 of Carbides in Nuclear Energy. Vol. 2. Russell, L. E. (ed.). London, Macmillan and Co., Ltd., 1964.

Rods of (UZr)C were produced for use in in-reactor thermionic energy converters. Using a two stage sintering process densities up to 97% theoretical density were obtained and the fabricated cathodes, brazed with Zr to Ta supports, withstood a minimum of 11 cycles in the 1000–2100°C temperature range without cracking. After operation in an in-pile converter for 45 hr the (UZr)C cathode was found to be broken but the breakage almost certainly occurred during postirradiation handling. The diameter and appearance of the rod surface remained unchanged. Measurements of thermal conductivity of (UZr)C at very high temperatures are presented and some examples of reaction of (UZr)C with refractory metals at high temperatures are given. (auth)

9401 THE SYNTHESIS OF (UZr)–C AT 5000 deg KELVIN. Gibson, J. O. (Vitro Labs., West Orange, N. J.). pp 816-25 of Carbides in Nuclear Energy. Vol. 2. Russell, L. E. (ed.). London, Macmillan and Co., Ltd., 1964.

$UC_{0.3}$ $ZrC_{0.7}$ has a potential operating temperature which will exceed that for unalloyed UC by about 1000°C. Accordingly, UC–ZrC, which is slightly hypostoichiometric in C, may prove to be of increasing interest in ultra-high temperature gas cooled reactors, in liquid metal bonded or liquid metal cooled reactors, and in the Cs thermionic diode. Recent research data on the synthesis of UC–ZrC spheres, which are slightly hypostoichiometric in C are presented. The process used for the synthesis employs consumable homogeneous electrodes which are fabricated from reactor grade UO_2, ZrO_2, and C. The fabricated electrodes are heated to temperatures of 5000°K by arcing the electrodes as anodes in a high intensity electric arc discharge. The homogeneous electrode serves several useful purposes: It introduces the UO_2, ZrO_2, and C into the reaction zone continuously and in the correct proportions; serves as an electrical conductor permitting the electrons to condense on the reaction zone heating the surface to a temperature of 5000°K; functions as the crucible or container where the liquid-phase carbothermic reduction reaction can proceed to completion to produce a pure liquid UC–ZrC and CO. The process produces molten spheres of UC–ZrC in controlled sizes from 1/4 in. down to 20 μ. The UC–ZrC then freezes as a dense single phase carbide having a purity of 99.975 wt %. Recent data on a mechanism which permits simultaneous compositional control of U, Zr, and C are presented graphically for several molar values. In addition, data on the fractional distillation of impurities from UC–ZrC at 5000°K are presented. The process described is uniquely qualified to produce a high density, high purity, single phase carbide of controlled composition and is especially attractive for processing high enrichments of ^{235}U. (auth)

9402 THE NEW FONTENAY-AUX-ROSES $\alpha\beta\gamma$ RADIOMETALLURGY LABORATORY DESIGN AND CONSTRUCTION. Valentin, A.; Portal, A. pp 92–101 of Proceedings of the 13th Conference on Remote Systems Technology, 1965. Hinsdale, Ill., American Nuclear Society, 1965.

A radiometallurgy laboratory was constructed at Fontenay-aux-Roses, where irradiated plutonium fuels, either prototypes or taken from French fast reactors, will be studied. The laboratory has a floor area of 1850 m^2 excluding change rooms, and contains twelve cells including one decontamination cell. The α-β-γ cells, with or without tight boxes, have a total "hot" area of 117 m^2. The first irradiated fuel examinations are planned for autumn 1966. Experience acquired at Saclay since 1961, running the α-β-γ metallurgy cells was used in the design. (auth)

9403 OPERATING EXPERIENCE WITH THE KAPL-RADIOACTIVE MATERIALS LABORATORY METALLOGRAPHY FACILITY. Wemple, B. D.; Jackson III, D. C.; LaRocque, D. D. (Knolls Atomic Power Lab., Schenectady, N. Y.). pp 142-51 of Proceedings of the 13th Conference on Remote Systems Technology, 1965. Hinsdale, Ill., American Nuclear Society, 1965.

In June 1963, the construction of a metallography facility was completed at the KAPL Radioactive Materials Laboratory. The facility was designed to improve the quality and quantity of metallographic work being performed. The operation of the new facility was as anticipated; however, several changes were made in the original equipment and procedures to further improve the operational efficiency. (auth)

9404 IMPROVEMENTS IN OR RELATING TO THE PRODUCTION OF METAL CARBIDE GRANULES. Devellard, Jacques; Peccoud, Michel (to Commissariat a l'Energie Atomique). British Patent 1,011,448. Dec. 1, 1965. Priority date June 21, 1963, France.

A method for the preparation of metal carbide granules (particularly UC) of a predetermined size range consists of fusing under vacuum by electron bombardment a presintered ingot of the carbide, and receiving the granules in a receptacle for further use. To ensure uniform granular size, the ingot is disposed above a rotatable water cooled copper plate onto which the droplets fall for cooling; and as the granules are removed from the plate, they are discharged into a crucible located in the same furnace for the formation of rods or bars by a continuous drawing process. (B.L.M.)

9405 PRODUCTION OF NIOBIUM BY VAPOR PHASE REDUCTION OF NIOBIUM PENTACHLORIDE. Brothers, James A.; Pesold, William F. (to Wyandotte Chemicals Corp.). U. S. Patent 3,216,822. Nov. 9, 1965. Filed Feb. 28, 1962.

A process is patented for the production of the metals of the group, Nb, Ta, Mo, and W, particularly Nb, by the reduction of the metal halides with Zn. Zinc vapor is passed into contact with the halide of the metal in a reaction zone maintained at a temperature of about 750 to 1100°C to effect reduction of the halide to produce a mixture of the metal and zinc halide. The metal is separated from the zinc halide by condensing and depositing the mixture at a temperature of from about 350 to 550°C. Heating the deposit to about 750 to 1100°C and passing an inert gas over the deposit serves to vaporize the zinc halide, and the gas flow carries away the vaporized halide to leave a deposit of the metal. (B.L.M.)

9406 PROCESS FOR MAKING ZIRCONIUM ALLOYS. Raine, Thomas; Robinson, James Alan (to Associated Electrical Industries Ltd.). U. S. Patent 3,218,162. Nov. 16, 1965. Filed Mar. 16, 1962.

A process of manufacturing a ternary alloy of Zr, 0.5 to 1.5 wt % of Cu, and 0.25 to 1.5 wt % of W consists of intimately mixing equal proportions by weight of powdered Cu and powdered W; sintering the mixture; melting the sintered mixture; adding Zr to form a master alloy of Cu, W, and Zr, and melting a required proportion of the master

alloy with additional Zr to obtain a homogeneous ternary alloy. (B.L.M.)

Corrosion

Refer also to abstract 10399.

9407 (BNWL–18) COMPATIBILITY BETWEEN PuO_2 AND 80 Ni/20 Cr. Carroll, D. F. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Jan. 29, 1965. Contracts AT(45-1)-1350; AT(45-1)-1830. 29p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

PuO_2 was found to be compatible with an alloy of 80 Ni–20 Cr at 1093°C for 400 hrs. The oxidation stability of a PuO_2–62 wt % (Ni–20 Cr) cermet heated in air to 1093°C is superior to that of a UO_2–62 wt % (Ni–20 Cr) cermet. UO_2, if not protected by cladding, is converted to U_3O_8 in 982°C air even though it is dispersed and impacted in the Ni–20 Cr alloy. The PuO_2 cermet can be diffusion bonded to Ni–20 Cr foil by pneumatic impaction at 1093°C and ~250,000 psi. The compatibility of PuO_2 with Ni–20 Cr cladding material is dependent on the Si content of the alloy. PuO_2 reacts with Si in the foil at 816°C. No evidence of PuO_2 diffusion through a 0.15 mm thick alloy foil was found after heating at 1093°C for as long as 400 hrs. (auth)

9408 (BNWL–154) EVALUATION OF IRON- AND NICKEL-BASE ALLOYS FOR MEDIUM AND HIGH TEMPERATURE REACTOR APPLICATIONS. PART II. Claudson, T. T.; Pessl, H. J. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Nov. 1965. Contract AT(45-1)-1830. 60p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

When alloys were exposed up to 1060°C for 500 hr in flowing He and N_2, that had been first passed through graphite at 450 to 500°C, AISI 406 stainless steel, PDRL-102, Hastelloy X and N, and the Fe–30 Cr–1 Y type experimental alloy showed the lowest weight gains and increased in the order listed. When exposed for 100 hr to pure, dry CO_2 while in contact with powdered graphite at 100°F temperature intervals up to 1093°C, Hastelloy X gained the least in weight and was followed by Inconel X-750, Hastelloy R-235, and AISI 406 stainless steel. Extensive autoclave testing of the selected alloys in oxygenated and deoxygenated superheated steam at 550°C and 1000, 3000, and 5000 psi pressure; and at 650°C and 600 psi pressure, respectively, established the following tentative grouping of alloys with increasing resistance to corrosion: AISI 304, 316, 406, and 430 stainless steels showed weight gains from about 50 to 300 mg/dm^2, or over 0.2 mil of penetration; Fe–25 Cr–3 Al–0.6 Y, Hastelloy N, PDRL-102 and Inconel X-750 showed weight gains from about 8 to 75 mg/dm^2, or 0.1 to 0.2 mil penetration; and, Incoloy 800, AISI 446 stainless steel, Hastelloy X-280, Hastelloy R-235, and Fe–2 Cr–5 Al showed weight gains below 15 mg/dm^2, or less than 0.1 mil penetration. The oxygen content and pressure of the steam appear to affect the various alloys in different ways. Susceptibility to stress-corrosion cracking of the plastically and elastically prestressed alloys in 42% boiling, aqueous, magnesium chloride solution was severest for the type 300 stainless steels, and considerably less severe for the 400 series stainless steels, the Fe–Cr–Al-base alloys, and the nickel-base alloys Hastelloy X and PDRL-102. AISI 406 stainless steel and Incoloy 800 appear to be most resistant to stress condition. The effects of neutron exposure upon the mechanical properties of several iron- and nickel-base alloys were determined. Generally, the comparative ambient pre- and postirradiation room temperature test results do not indicate any pronounced property changes because of irradiation, except for slight losses in strength and elongation. When tested at 700°C, radically different effects of irradiation were observed. In addition to a general deterioration of the tensile properties (which is to be expected at this testing temperature), most alloys suffer varying severe losses of yield and ultimate strength due to irradiation and a most pronounced decrease in elongation. These effects are least noticeable in the stainless steels where the 406 SS shows greatly increased elongation caused by irradiation. (W.L.G.)

9409 (BNWL–155) AN EVALUATION OF THE CORROSION RESISTANCE OF SEVERAL HIGH TEMPERATURE ALLOYS FOR NUCLEAR APPLICATIONS. Claudson, T. T.; Westerman, R. E. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Nov. 1965. Contract AT(45-1)-1830. 26p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

The results showed the comparative oxidation resistance of 10 high-temperature alloys in an oxidizing environment of helium and water vapor. It was found that large weight gains are primarily associated with intergranular corrosion and internal oxidation of the alloy. At 815°C in an atmosphere of low pressure water vapor, Hastelloy C, Hastelloy N, Hastelloy X-280, Inconel 600, Inconel 625, and Haynes 25 have more superior corrosion resistance than the other four materials tested. Weight gains of less than 0.3 mg/cm^2 were observed for these better materials after 300 hr of exposure. Inconel 718, Inconel 702, and Incoloy 800 were more resistant to corrosion than Hastelloy R-235, the least corrosion resistant of all the alloys tested at this temperature. At 930°C, the same relative grouping was found as in the 815°C data. However, more definite evidence of intergranular attack was found in Haynes 25, Inconel 718, and Inconel 600 at 930°C than at the 815°C test temperature. At 1038°C, definite and gross intergranular attack and internal oxidation was found in alloys. Hastelloy C, Hastelloy N, Hastelloy X-280, and Haynes 25 exhibit the best resistance to oxidation, and Inconel 600, Inconel 702, Incoloy 800, and Inconel 625 followed in order. At all test temperatures, Hastelloy R-235 showed the worst attack. Inconel 625 exhibited increasing amounts of grain boundary attack and subsequent internal oxidation with increasing test temperature. (W.L.G.)

9410 (BNWL–166, pp 5.1-3) ATR GAS LOOP SUPPORT. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Samples of Haynes Alloy 25, Hastelloy X-280, and Nichrome were prefilmed with oxide of various thicknesses in air at 2050°F to determine if these films constituted barriers to metal evaporation. Upon exposure to static vacuum conditions at the same temperature, all oxides formed lost adherence and continuity, and allowed the substrate metal to evaporate. (auth)

9411 (BNWL–166, pp 5.4-6) PRODUCTION REACTOR CORROSION AND COATINGS STUDIES. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

The application of small d-c potentials to a Zircaloy-2 cathode in process water was found to induce hydrogen absorption by the Zircaloy. The potential may be applied or generated by a galvanic couple. The efficiency of the hydrogen pickup is higher in the early stages of the hydriding process and at the lower potentials. The effect of a-c on this process is not certain. (auth)

9412 (BNWL–166, pp 5.7-10) N-REACTOR CORROSION AND HYDRIDING STUDIES. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Prefilmed Zircaloy-2 was vacuum annealed inside and outside a shield made from Zircaloy-2. The postanneal oxidation behavior of shielded and unshielded samples was comparable, indicating no effect of nitrogen or silicon impurities picked up during the anneal. On coupons annealed to completely dissolve the oxide films, the postanneal oxidation rate increased immediately and underwent a marked transition 15 to 25 days after the anneal. Removal of ~3000 Å from the annealed surface by etching in an aqueous HNO_3–HF solution suppressed the first acceleration, but the transition occurred as in the case of unetched coupons. (auth)

9413 (CONF-650620, pp 1-17) MECHANICAL PROPERTIES OF MATERIALS IN SODIUM. Andrews, R. C.; Tepper, F. (MSA Research Corp., Callery, Pa.).

Results from studies on the effects of exposure to high-carbon and high-oxygen sodium at 1200°F on the mechanical properties of 2¼ Cr−1 Mo steel and types 304 and 316 stainless steels are summarized. (W.L.G.)

9414 (CONF-650620, pp 18-35) GENERAL ELECTRIC SODIUM MASS TRANSFER PROGRAM. Young, R. S.; Lockhart, R. W. (General Electric Co., San Jose, Calif. Advanced Products Operation).

Results of studies on the mass transfer and corrosion of type 316 stainless, 2¼ Cr−1 Mo, and 5 Cr−½ Mo−½ Ti steels in flowing sodium are summarized. The effects on mass transfer of three primary variables: loop maximum temperature, overall loop temperature drop, and oxide impurity level as measured by plugging temperature were determined. (W.L.G.)

9415 (CONF-650620, pp 105-26) EVALUATION OF THE PERFORMANCE OF MATERIALS IN SODIUM IN THE SRE. Mannas, D. A. (Atomics International, Canoga Park, Calif.).

The examination of the heat transfer system to determine the effects of the sodium environment on the components is described. (W.L.G.)

9416 (CONF-650620, pp 127-32) EBR-II MATERIALS EXPERIENCE. Scheibelhut, C. H. (Argonne National Lab., Idaho Falls, Idaho).

The EBR-II secondary sodium system and material failures encountered during reactor operation are described. (W.L.G.)

9417 (CONF-650620, pp 156-65) INTERATOM ACTIVITIES IN THE FIELD OF SODIUM TECHNOLOGY. Harde, R. (Internationale Atomreaktorbau G.m.b.H., Bensberg (West Germany)).

Some aspects of the use of carbon-stabilized low-alloy ferritic steel in high temperature sodium systems and steam generator safety problems are discussed. Results of experience gained at INTERATOM during the construction and startup of a ferritic steel 5 Mw Component Test Facility is reported and the results of sodium−water interaction experiments outlined. (W.L.G.)

9418 (CONF-650620, pp 204-31) SODIUM HEATED STEAM GENERATOR DESIGN AND MATERIALS EXAMINATION OF A MODEL STEAM GENERATOR. Fortner, E.; Koch, D. W.; Kovach, P. J.; Probert, P. B. (Babcock and Wilcox Co., Alliance, Ohio. [Research Center]).

The completed preliminary designs of the full-size steam generator and the prototype steam generator are described. A test program to assess the compatibility of Croloy 2¼ and type 316 stainless steel particularly with reference to the design parameters of the full size steam generator is described. Results of a metallurgical examination of piping removed from a model sodium heated steam generator during intermediate shutdown after 1000, 2000, and 4000 operating hrs are presented. (auth)

9419 (CONF-650620, pp 232-43) REVIEW OF ATOMIC POWER DEVELOPMENT ASSOCIATES' SODIUM-WATER REACTION PROGRAM. Muenchow, H. O. (Atomic Power Development Associates, Inc., Detroit, Mich.).

The research program and associated test facility are described. The objectives of the program are: establish a means of estimating the extent of tube wastage during a small leak of water into the sodium of a sodium-heated steam generator; and, determine the dominant parameters of tube wastage during a small water leak so that they may be applied to the design of a unit. (W.L.G.)

9420 (DP-990) LEAKS IN RADIOACTIVE-WASTE TANKS. Girdler, R. M. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). Dec. 1965. Contract AT(07-2)-1. 30p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

A number of leaks developed in four of sixteen underground storage tanks used for storage of alkaline radioactive waste from the separations area at the Savannah River Plant. The tanks are 75 to 85 feet in diameter and were field erected by welding; the welds were not stress relieved. The investigation of these leaks revealed no correlation with the history of the construction or usage of the tanks. Stress corrosion cracking is the most likely explanation of the leaks. Similar stress corrosion cracking in tanks of this type can be prevented by full stress relieving after welding has been completed. (auth)

9421 (EURAEC-1486) QUARTERLY REPORT NO. 11 [ON STAINLESS STEEL], JULY 1-SEPTEMBER 30, 1965. Chaudron, G. (Centre National de la Recherche Scientifique, Paris (France)). Contract 059-65-1 TEE F (RD). 19p. (EUR-2653). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

Work Performed under United States-Euratom Joint Research and Development Program.

High-purity stainless steels were prepared and their oxidation resistance to steam at 500°C compared with type 304 stainless steel. An 18/10 steel had a 50% larger weight gain and 18/10 steel with 1 and 4% Si additions had 30 and 50% smaller weight gains, respectively, than the type 304 stainless steel. The influence of tempering on the mechanical properties of high-purity 18/8 steels with 18 and 70 ppm C was studied. The steel with 70 ppm C had the lower hardness and ultimate tensile strength and the higher elongation at rupture. The 18 ppm C steel maintained its maximum hardness for much longer tempering periods. The martensitic structure was less stable in the 70 ppm C steel and the hardness disappeared entirely after 100 hrs of tempering at 450°C. (W.L.G.)

9422 (NAA-SR-11326) AN INVESTIGATION OF NICKEL-BASE BRAZING ALLOYS AND BRAZED JOINTS FOR SERVICE IN LIQUID SODIUM. Lee, Suk K. (Atomics International, Canoga Park, Calif.). Dec. 15, 1965. Contract AT(11-1)-Gen-8. 35p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

A series of nickel-base brazing alloys were tested in a liquid sodium thermal convection loop for a period of 10,000 hr at temperatures of 1200 and 700°F. The tests were conducted to establish the feasibility of a brazed calandria joint concept for the sodium graphite reactor application. The results indicated that Ni−Cr−Si−B (CM53) and Ni−Si−B (CM52) were the most resistant to sodium attack. The Ni−Cr−Si (CM60) would only be suitable for short term use (less than 1500 hr) or lower temperature (below 700°F) applications. A continued rise in remelt temperature, due to loss of brazing alloy melting temperature depressant constituents (Si and B) and to erosion of the joint parent material, will limit the number of cycles for rebraze and remelt of the calandria joints. The existing calandria joint design is susceptible to cracking and porosity formation, consequently joint integrity is questionable. It is believed however, that this may be overcome by joint design changes. (auth)

9423 (NASA-CR-54735) POTASSIUM CORROSION TEST LOOP DEVELOPMENT. Quarterly Progress Report No. 7, January 15, 1965-April 15, 1965. Hoffman, E. E. (ed.) (General Electric Co., Cincinnati, Ohio. Space Power and Propulsion Section). Contract NAS3-2547. 109p.

The evaluation of Component Evaluation Test Loop II was substantially completed. The loop components performed in a satisfactory manner and both metallographic examination and chemical analyses of loop tubing indicated that no significant corrosion had occurred during the 2650-hr test at 2000°F with liquid Na. All major subassemblies of the Prototype Corrosion Loop were completed. Following annealing of the condenser−turbine simulator, an iron titanate high emittance coating was applied to the Nb−1Zr alloy fins of the condenser. Fabrication of the numerous alkali metal purification and transfer system components was essentially completed. The Na for the primary circuit of

the Prototype Loop was purified by hot trapping with Zr foil. Purification of the K for the secondary circuit of the loop is underway. Calibration of numerous components of the Prototype Loop, including the partial pressure analyzer, refractory alloy thermocouples, flowmeter magnets, and pressure transducer, was completed. The 2500-hr, 2000°F refluxing K test to determine the compatibility of TZM alloy in the condensing region of a Nb–1Zr alloy capsule was completed and a preliminary evaluation performed. Weight change data indicate no significant compatibility problems. A second capsule test is being continued for a total of 5000 hrs to determine the effect of time on interactions in this three component system. (W.L.G.)

9424 (NASA-CR-54844) STUDIES OF ALKALI METAL CORROSION ON MATERIALS FOR ADVANCED SPACE POWER SYSTEMS. Quarterly Progress Report No. 5, June 26, 1965–September 26, 1965. Harrison, R. W. (General Electric Co., Cincinnati, Ohio. Space Power and Propulsion Section). Contract NAS3-6012. 23p.

The D-43 Alloy Stress Corrosion Reflux Capsule Test I completed 1000 hrs of testing at a nominal temperature of 2100°F and was removed from the test facility. Equivalent uniaxial creep strains of 7.4% in the liquid region and 5.4% in the condensing region were calculated from expansion data. The capsule was drained of K, cleaned and sectioned. Although examination of the inner surface of the capsule revealed the presence of spots in the liquid and condensing regions, further investigations indicated no association between the location of the spots and the regions of high stress. Lower uniaxial creep strengths were obtained from capsule test data than were predicted by pretest and literature data. (auth)

9425 (ORNL–3898) SNAP-8 CORROSION PROGRAM SUMMARY REPORT. Savage, H. W.; Compere, E. L.; Huntley, W. R.; Fleischer, B.; MacPherson, R. E.; Taboada, A. (Oak Ridge National Lab., Tenn.). Dec. 1965. Contract W-7405-eng-26. 207p. Dep. mn; CFSTI $6.00 cy, $1.25 mn.

The results of the SNAP-8 Corrosion Program led to the following conclusions concerning the SNAP-8 reactor system and the corrosion test loops: The most pronounced performance-deteriorating corrosion phenomenon expected in the SNAP-8 primary circuit is C migration from the Croloy 9M to the rest of the system. Decarburization of Croloy 9M from 0.11% C to as low as 0.002% C results in considerable loss in mechanical properties. Corrosion of Hastelloy N is manifested as intergranular attack. The depth of corrosion damage is therefore greater than that expected from weight-change measurements. Maximum attack in the SNAP-8 system having an O_2 level of less than 30 ppm will occur on the Hastelloy N at the outlet end of the reactor. Extrapolation of data indicates that corrosion at this point will be less than 1½ mils in 10,000 hr at 1300°F. Corrosion at low-flow 1450°F hot-spot areas will be less than that occurring at high-flow 1300°F areas due to influence of velocities. The corrosion behavior of the system materials is not deleteriously affected by H_2 at simulated SNAP-8 levels. O_2 was found to be the most important factor affecting corrosion of the Fe-base materials. The Ni-base material, Hastelloy N, was sensitive to O_2 only at very high concentrations. Initial cold trapping for removal of O_2 was found to be sufficient for O_2 control. This was demonstrated in a 5133-hr loop test in which the measured O_2 concentration remained at <30 ppm throughout the test. Corrosion results further confirmed that low-O_2 conditions prevailed during operation. The high affinity of Cr for O_2 resulted in the removal of O_2 from NaK by deposition of $Na_2O \cdot Cr_2O_3$ in the cold leg in high-O_2 loops. Cr was selectively leached from all materials in the hot leg of the loops. Mass-transfer deposits generally tend to build up in the electromagnetic pump cell and at flow disturbance regions in the cold leg. In low-O_2 loops, deposits consisted mostly of Ni, Cr, and Mn. In the high-O_2 loops the deposits were mostly Fe and Cr. In the low-O_2 NaK, corrosion of the Hastelloy N was very sensitive to temperature changes while the Fe-base alloys were virtually unaffected. Long-time exposure of types 316 and 347 stainless steel at SNAP-8 temperatures will result in microstructure changes involving the formation of sigma phase, carbides, and other unidentified phases. Some loss in ductility can be expected from these changes. C diffusion from Croloy 9M is apparently a function of both the decomposition rate of Cr_7C_3 and the diffusivity of C in α-(Fe,Cr). Migration of Ni to Croloy 9M causes C activity changes in the Croloy 9M surface which result in uphill diffusion of C. The extent of C migration is not increased by injection of H_2 into the loop. Control and monitoring of O_2 level was the single most important factor in the operation of the corrosion loops. Measurement of O_2 level using plugging indicators is subject to interpretation because of the multibreak results in the curve. Ar removal from NaK due to differential temperature solubilities was observed to cause a spurious break in the O_2 plugging curve. Deuterium injection was a useful technique to eliminate the effects of extraneous H_2 in studying H_2 deposition in the loops. Cold trapping is an effective means of reducing the H_2 level in NaK and can be used in SNAP-8 to reduce diffusion of H_2 into the Hg circuit. The permeation rate of H_2 through type 316 stainless steel is not altered by the presence of NaK. The solubility of H_2 in NaK for unsaturated solutions depended on the square root of the H_2 pressure and varied only slightly with temperature. The activity of H_2 in NaK can be considerably diminished by the addition of Li. This is a potential means of controlling H_2 egress from the SNAP-8 primary system. (W.L.G.)

9426 (TID-12809) COLUMBIUM FUEL ELEMENT DEVELOPMENT. Lever, R. C.; Wukusick, C. S. (General Electric Co., Cincinnati, Ohio. Aircraft Nuclear Propulsion Dept.). May 16, 1961. Contracts AF33(600)-38062; AT(11-1)-171. 26p. (XDC-61-5-45). Dep. mn; CFSTI $2.00 cy, $0.50 mn.

Protective coatings were developed for Nb that withstood exposure to air at 2500°F for 1400 hrs. However, the coatings spalled in the temperature range of 1200 to 1600°F. Ti was added to the original composition of Al–Nb and initial results indicate satisfactory performance. (W.L.G.)

9427 (WAPD-TM-546) DEVELOPMENT OF ZIRCONIUM-BASE ALLOYS. Bourgeois, W. F.; Chirigos, J. N. (Bettis Atomic Power Lab., Pittsburgh, Pa.). Nov. 1965. Contract AT-11-1-Gen-14. 44p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

An experimental program was conducted in order to develop an alloy having corrosion resistance superior to Zircaloy-2 in steam at temperatures greater than 750°F but with hydrogen pickup and corrosion resistance in water at least equal to that of Zircaloy-2. Corrosion results, hydrogen absorption, hardness, and some tensile data are presented for six zirconium-base alloys containing from 0 to 1 wt% tin, iron, and chromium after 311 days in 680°F water, 259 days in 850°F steam (1500 psi), 176 days in 950°F steam (1500 psi), and 30 days in 1150°F steam (15 psi). It was concluded that four alloys are particularly promising for high-temperature steam applications and, of these, a ternary alloy of sponge zirconium with 0.5 wt% iron and 1.0 wt% chromium appears to have the best combination of overall properties. (auth)

9428 HIGH TEMPERATURE OXIDATION OF CARBON BY ATOMIC OXYGEN. Rosner, D. E.; Allendorf, H. D. (AeroChem Research Labs., Inc., Princeton, N. J.). Carbon, 3: 153-6(Oct. 1965).

The true kinetics of the attack of high-temperature graphite by both atomic and diatomic oxygen were studied using microwave discharge-fast flow system techniques. In the surface temperature range from 1100 to 2000°K the oxidation probability for O-atom attack exceeded that for O_2 by factors between 5 and as much as 80, passed through a maximum in this temperature range (as did the O_2 attack probability on the same surface), and was independent of

oxygen partial pressure (corresponding to a first order reaction), in contrast to the kinetic order of the O_2/carbon reaction. Several mechanistic implications of these results are discussed. (auth)

9429 REACTION OF FLOWING STEAM WITH REFRACTORY METALS. II. RHENIUM (850 deg –1700 deg C). Kilpatrick, Martin; Lott, Stanley K. (Argonne National Lab., Ill.). J. Electrochem. Soc., 113: 15-16 (Jan. 1966).

When rhenium reacts with steam at 1 atm pressure, the rate of evolution of hydrogen is constant with time, and the metal remains bright with no evidence of a coating. The apparent energy of activation for the reaction is 30 kcal/mole, and the enthalpy of sublimation of Re_2O_7 is 33.5 kcal/mole, which suggests that the rate-determining step is the sublimation of the oxide. (auth)

9430 REACTION OF FLOWING STEAM WITH REFRACTORY METALS. III. TUNGSTEN (1000 deg –1700 deg C). Kilpatrick, Martin; Lott, Stanley K. (Argonne National Lab., Ill.). J. Electrochem. Soc., 113: 17-18 (Jan. 1966).

The mechanism of the reaction of tungsten with steam over the temperature range from 1000 to 1450°C was similar to that for the reaction of molybdenum. The rate-determining step consisted of the oxidation of WO_2 (s) to the volatile $WO_2(OH)_2$ and WO_2 and its polymers. Above 1450°C the reaction was complicated by the formation of a liquid phase on the surface of the metal. (auth)

9431 SOLID-STATE ANODIC OXIDATION OF TANTALUM. Smyth, D. M. (Sprague Electric Co., North Adams, Mass.). J. Electrochem. Soc., 113: 19-24 (Jan. 1966).

When an anodic potential was applied to a tantalum point contact to MnO_2, the current-voltage behavior was analogous to that observed during the anodic oxidation of a valve metal in an aqueous electrolyte. It is proposed that this represents a solid-state anodic oxidation whereby tantalum oxide is formed at the expense of the local oxygen content of the MnO_2, and that this process represents an important mechanism in the $Ta-Ta_2O_5-MnO_2$ solid electrolyte capacitor. This process requires that the conductivity of the reduced manganese oxide phase, which must be formed adjacent to the Ta_2O_5, have a finite ionic portion, and experimental support for this is described. The current efficiency of the solid-state anodization is very low and is dependent on ambient moisture. Similar behavior was found for aluminum and niobium point anodes and with PbO_2 as the cathode. (auth)

9432 THERMODYNAMICS FOR COMPATIBILITY STUDIES OF METAL CLAD URANIUM CARBIDE. Alexander, C. A. (Battelle Memorial Inst., Columbus, Ohio); Ward, J. J.; Ogden, J. S.; Cunningham, G. W. pp 192-207 of Carbides in Nuclear Energy. Vol. 1. Russell, L. E. (ed.). London, Macmillan and Co., Ltd., 1964.

Thermochemical data for the carbides of Mo, Nb, Ta, Ti, W, U, Hf, and Zr were critically reviewed and the free energy of formation as a function of temperature was calculated for these carbides. In addition, effusion data were obtained for UC, U_2C_3, and UC_2 at temperatures to 2500°K. Free energy equations calculated as a function of temperature are in good agreement with high temperature heat content data, calorimetric values for ΔH^0_{298}, ΔS^0_{298}, and phase diagrams reported in the literature. However, the effusion data do not agree with most other effusion data reported in the literature. On the basis of these data, metal claddings of Nb, Ta, Ti, Zr, and Hf would be expected to react with uranium carbides in the temperature range 1000-2000°C. Data are insufficient to predict the behavior of Mo, but W should not react extensively with stoichiometric UC below 1700°C. The monocarbide, UC, is the most stable of the uranium carbides in contact with the metals listed, and U_2C_3 and UC_2 would be expected to react with all the metals over the entire temperature range 1000-2000°C. A detailed discussion of the method used to predict compatibility on the basis of thermochemical and diffusion data is given for Nb and U_2C_3. (auth)

9433 ATMOSPHERIC CORROSION OF URANIUM–CARBON ALLOYS. Rousset, P. (Centre d'Etudes Nucleaires de Saclay, Gif-sur-Yvette, France); Accary, A. pp 280-7 of Carbides in Nuclear Energy. Vol. 1. Russell, L. E. (ed). London, Macmillan and Co., Ltd., 1964.

In order to specify suitable machining, cleaning and storage conditions, the corrosion of U–C alloys, with compositions close to that of UC, was studied and correlated with the water content of different surrounding media (organic liquids and gases). In liquid media, there is a close correlation between the extent of the corrosion and the water content of the liquid. In gaseous media, corrosion results in either a gain or loss in weight depending on the nature of the gas and the time of exposure. In a poor vacuum there is more extensive corrosion than in air or argon with the same water content. It is concluded that the atmospheric attack on U–C alloys proceeds by a stress-corrosion mechanism. (auth)

9434 OXIDATION OF UC–10 percent Fe. Peakall, K. A. (Atomic Energy Research Establishment, Harwell, Eng.); Antill, J. E. pp 288-96 of Carbides in Nuclear Energy. Vol. 1. Russell, L. E. (ed.). London, Macmillan and Co., Ltd., 1964.

Arc-melted UC–10 wt% Fe was oxidized in carbon dioxide at 500-900°C, in steam at 300-1000°C, and in water at 80°C. A linear rate law was mostly obeyed for the conditions studied with the rates of attack being less than those for 86-90% dense sintered UC, a reference sintered material; the factors of improvement were 4-250 in carbon dioxide, 10-4000 in steam and >300 in water. While most of the improvement in carbon dioxide may be attributed directly to an increase in the density of the sample with a reduction in the available surface area, it is probable that the chemistry of the oxidation process was altered in steam and water. (W.L.G.)

9435 THE BEHAVIOR OF CARBIDES IN HYDROGEN AND OXYGEN. Sowden, R. G. (Atomic Energy Research Establishment, Harwell, Eng.); Hodge, N.; Moreton-Smith, M. J.; White, D. B. pp 297-314 of Carbides in Nuclear Energy. Vol. 1. Russell, L. E. (ed.). London, Macmillan and Co., Ltd., 1964.

Studies were made of the reaction of UC_2, $(UPu)_2C_3$ and Pu_2C_3 with flowing hydrogen. At a temperature of about 1000°C it is possible to reduce the di- and sesqui-carbides to a monocarbide phase. Experience indicates that removal of carbon and sintering to a high density can be carried out in a single operation. The reaction of uranium and plutonium carbides with oxygen was investigated at atmospheric and reduced pressure. At atmospheric pressure, ignition occurs at a temperature which is greatly dependent upon the surface area of the carbide. At low pressure, ignition of finely divided uranium monocarbide can be avoided by using gold dust as a heat dispersant: under such conditions, oxidation below 220°C does not involve evolution of carbon dioxide, and the rate appears to be controlled by diffusion of oxygen through a layer of oxide. The chemical reactivity of carbides is of considerable importance to their development as nuclear fuels. Reaction with hydrogen affords a potentially valuable means of removing excess carbon at the end of fuel preparation or fabrication processes. A knowledge of the rate and extent of reaction with oxygen is desirable at all stages in the manufacture of carbides. (auth)

9436 THE VOLATILITY OF PLUTONIUM CARBIDE. Palfreyman, M. (Atomic Energy Research Establishment, Harwell, Eng.); Potter, P. E. pp 336-41 of Carbides in Nuclear Energy. Vol. 1. Russell, L. E. (ed.). London, Macmillan and Co., Ltd., 1964.

Measurements of the rate of evaporation from arc-melted hypostoichiometric plutonium carbide were made by the vapor transpiration technique using Ar as the flow gas at temperatures from 1500-1565°C. The nature of the gaseous species is discussed and a possible vapor pressure computed. (auth)

9437 PROPERTIES OF SOLID SOLUTION URANIUM–PLUTONIUM CARBIDES. Stahl, D. (United Nuclear Corp.,

White Plains, N. Y.); Strasser, A. pp 373-91 of Carbides in Nuclear Energy. Vol. 1. Russell, L. E. (ed.). London, Macmillan and Co., Ltd., 1964.

Out-of-pile properties of $(U_{0.8}Pu_{0.2})C$ and $(U_{0.95}Pu_{0.5})$ containing 2000 to 4000 ppm 0_2 were measured. The measurements included: melting point, coefficient of expansion, vapor pressure, and compatibility. Compatibility tests were made in a differential thermal expansion capsule at 590 and 820°C for 1000 and 4000 hrs. In general, there was no reaction between the carbides and type 316 stainless steel, Nb, Nb–1 wt% Zr, and V. Reactions were noted between the carbides and Zircaloy-2 and Inconel X. Some in-pile thermal conductivity estimates are given. (W.L.G.)

9438 COMPATIBILITY OF (UPu)–CARBIDES WITH CLADDING MATERIALS. Batey, W. (Dounreay Experimental Reactor Establishment, Caithness, Scotland); Bolton, K.; Donaldson, D. M.; Yates, G. pp 392-402 of Carbides in Nuclear Energy. Vol. 1. Russell, L. E. (ed.). London, Macmillan and Co., Ltd., 1964.

The compatibility of a range of cladding materials with mixed (UPu) carbides of varying C content was investigated. Carbide pellets of known composition were heated in contact with polished end-pieces of the cladding materials at 650 and 800°C, in some instances, in an Ar atmosphere. Preliminary results after test periods of 700 and 2100 hrs show reaction between 316L stainless steel, Nimonic 80A, and Nimonic PE16 with hyperstoichiometric (UPu) carbide pellets but no reaction with Mo. There is no evidence of reaction between these four materials and nominally stoichiometric mixed (UPu) carbide pellets. (auth)

Fabrication

Refer also to abstracts 9497, 9501, 10314, and 10358.

9439 (AECL–2511) A TECHNIQUE FOR LOW TEMPERATURE HYDRIDING OF ZIRCONIUM ALLOYS. Sexton, E. E. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). Nov. 1965. 12p. Dep. AECL $0.50.

A method of sample preparation was developed which would enable gaseous hydriding of zirconium alloys at temperatures of 500°C and below. The method was developed to accommodate a demand for the hydriding of cold-worked mechanical test specimens, where higher hydriding temperatures could not be used since annealing out of the cold work would have resulted. It was found that hydrogen could be introduced at temperatures as low as 280°C by vapor blasting the specimen prior to hydriding, followed by homogenizing. (auth)

9440 (CONF-650620, pp 178-203) MODULAR STEAM GENERATOR FABRICATION. Bogaert, L. T.; Casey, D. F. (Atomics International, Canoga Park, Calif.).

The design and fabrication techniques for an evaporator and superheater modular steam generator for the Sodium Component Development Program is described. The evaporator was fabricated from a 5 Cr–0.5 Mo steel and the superheater from type 321 stainless steel with a type 304 stainless steel shell. (W.L.G.)

9441 (EURAEC–1352) THE WELDING OF HEAVY-GAGE STEELS. Quarterly Report No. 14, January 1–April 15, 1965. (Ghent Rijksuniversiteit (Belgium). Soudometal, S. A., Brussels (Belgium)). Contract 042-61-9RDB. 50p. (EUR–2327) Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Work Performed under United States–Euratom Joint Research and Development Program.

Details and results of Robertson tests on symmetrical and asymmetrical welded joints and tensile tests on welded joints containing existing defects in steel plates 30 and 100 mm thick are reported. (W.L.G.)

9442 (EURAEC–1518) WELDED JOINTS ON HEAVY-GAGE STEEL SHEETS. Quarterly Reports 4 and 5. (Institut de Soudure, Paris (France)). Nov. 30, 1965. Contract 007-64-TEEF(RD). 19p. (EUR–2670). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Work Performed under United States–Euratom Joint Research and Development Program.

Development of an oxygen-chamfering process for preparing grooves in thick steel plates for welding studies is reported. (W.L.G.)

9443 (EURAEC–1473) METHODS IN THE FABRICATION OF PRESSURE VESSELS. Quarterly Report No. 14, July 1–September 30, 1965. (Neratoom, N. V., The Hague (Netherlands)). Contract 069-61-12RDN. 13p. (EUR–2394). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Work Performed under United States–Euratom Joint Research and Development Program.

The effects of varying the Cr, Ni, and Mo contents of the weld metal on the tensile properties of welds produced by gas arc welding under CO_2 was measured. It is concluded to be feasible to weld 200 mm thick 1.2 MDO7 steel by the boxed CO_2 method using solid weld wire and with three electrodes. (W.L.G.)

9444 THE CASTING AND EXTRUSION OF REFRACTORIES. Magnier, P.; Marchal, M.; Trouve, J.; Accary, A. (CEN, Saclay, France). Bull. Soc. Franc. Ceram., No. 66, 23-38(Jan.-Mar. 1965). (In French).

It is shown that the traditional methods for the continuous casting and extrusion of metals and alloys can be extended to the shaping of non-metallic materials. Continuous casting was extended to the shaping of other refractory carbides, in addition to UC, and to alumina. Extrusion, which was also applied to uranium monocarbide by the use of graphite dies, was extended to the extrusion of uranium dicarbide. Products obtained by continuous casting are characterized by their very low impurity content; test-pieces that were extruded had a highly orientated structure. Possible extensions to the field of application of these methods are indicated as well as their limitations. (auth)

9445 THE SINTERING OF BERYLLIUM OXIDE. Morize, P. (CEN, Saclay, France). Bull. Soc. Franc. Ceram., No. 66, 47-57(Jan.-Mar. 1965). (In French).

Results obtained by different methods of sintering are described. It is shown that beryllium oxide can be rapidly sintered to densities near to the theoretical by processes such as pressure sintering and ordinary sintering with or without additions, by increasing the temperature up to 1600°C. The preparation of the oxide powder is described and the sintering of powders derived from the sulfate and from the hydroxide is discussed. By combining the effect of the conditions of sintering (atmosphere and rate and duration of heating) with those of the crystal size of the oxide powder, it is possible to obtain sintered materials with a density, grain size, and, sometimes, porosity distribution selected. (auth)

9446 ABSORPTION FACTORS FOR A MODIFIED BACON PREFERRED-ORIENTATION TECHNIQUE. Bokros, J. C. (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Carbon, 3: 167-74(Oct. 1965). (GA–6031).

Absorption factors for a modified Bacon preferred-orientation technique were calculated for specimen sizes and densities encountered in practice. The technique is used in studies of film carbons deposited in fluidized beds. (auth)

9447 VARIATION IN THE CRYSTALLINITY OF CARBONS DEPOSITED IN FLUIDIZED BEDS. Bokros, J. C. (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Carbon, 3: 201-11(Oct. 1965). (GA–6050).

Carbons deposited in fluidized beds were studied, using x-ray scattering techniques to determine the concentration of amorphous carbon and misaligned single layers in each. It was found that small amounts of amorphous carbon can be present in carbons deposited at 1400°C and that the amount present increases with the deposition rate. The concentration of misaligned single layers in these carbons varied from 23% in the low-density carbon deposited from 5% methane to less than 2% in the high-density anisotropic carbon deposited from 40% methane. This decrease in the concentration of single layers with methane concentration

occurred regardless of a concomitant increase in deposition rate. The carbons deposited at 1650°C and above had no detectable amorphous carbon in their structures. The low-density, isotropic carbon deposited at a very high rate at 1650°C was found to contain about 10% single misaligned layers compared with 1% to 2% in the carbons deposited at 1900 and 2000°C. Possible models of carbon deposition consistent with the observed variations in structure with deposition conditions are presented. (auth)

9448 THE ELECTRODEPOSITION OF COHERENT DEPOSITS OF REFRACTORY METALS. III. ZIRCONIUM. Mellors, G. W.; Senderoff, S. (Union Carbide Corp., Parma, Ohio). J. Electrochem. Soc., 113: 60-6(Jan. 1966).

Exploratory experiments in chloride, bromide, and mixed chloride-fluoride melts always produced dendritic zirconium deposits. Pure fluoride systems consisting of ZrF_4 dissolved in alkali fluoride solvents produced coherent deposits of metal, some as thick as 0.1 in., on electrolysis at 750°C and 30 ma/cm² cathode current density. Analysis and material balance experiments showed that reduced compounds were absent in these fluoride systems. Chronopotentiometric measurements indicated that the zirconium is deposited from the tetravalent state in a single four-electron step, which appeared to be irreversible. The addition of KBF_4, K_2TiF_6, and Al_2O_3 to a working zirconium bath resulted in the deposition in coherent form of the compound ZrB_2 and the alloys Zr–Ti and Zr–Al. The ZrB_2 plate was 11 mils thick and showed no evidence of reaching an upper limit of thickness, while both alloys were smooth and fine-grained in nature. The Zr–Al deposit showed a rhythmic banded structure. (auth)

9449 THE ELECTRODEPOSITION OF COHERENT DEPOSITS OF REFRACTORY METALS. IV. THE ELECTRODE REACTIONS IN THE DEPOSITION OF NIOBIUM. Senderoff, S.; Mellors, G. W. (Union Carbide Corp., Parma, Ohio). J. Electrochem. Soc., 113: 66-71(Jan. 1966).

The mechanism for the electrodeposition of coherent deposits of niobium from a molten fluoride electrolyte was studied by means of chronopotentiometry and compared with that of tantalum. Reduction of the pentavalent niobium in solution occurred in three steps: a reversible one-electron step to the tetravalent state at −0.11v (referred to the Ni/Ni^{2+} electrode), a reversible three-electron step to the monovalent state at −0.76v, and an irreversible one-electron reduction to metal at −1.02v. However, the reaction $3Nb^{V} + Nb^{I} \rightarrow 4Nb^{IV}$ interfered with coherent metal deposition from the pentavalent solutions, and consequently in order that coherent metal be produced at high efficiency the mean valence of the bath had to be reduced to approximately four. In these circumstances the chronopotentiogram of a working bath showed two steps only: a three-electron reduction, $Nb^{4+} + 3e^{-} \rightarrow Nb^{1+}$ at −0.76v followed by the metal producing step $Nb^{1+} + e^{-} \rightarrow Nb^{0}$ at −1.02v. The diffusion coefficient of $[NbF_7]^{-2}$ was found to be 2.03×10^{-5} $cm^2\ sec^{-1}$ at 750°C and its activation energy for diffusion to be 8.75 kcal/mole. The diffusion coefficient of the tetravalent species was 5×10^{-5} $cm^2\ sec^{-1}$ at 750°C. (auth)

9450 URANIUM OXIDE–TUNGSTEN CERMETS OBTAINED BY ACTIVATED SINTERING. Amato, I.; Colombo, R.; Protti, A. M. (FIAT, Turin). Mem. Sci. Rev. Met., 62: 619-24(Sept. 1965). (In French).

Addition of activating substances to UO_2-W mixtures improved homogenization and favored densification. Sintering increased the electrical and thermal conductivities. (auth)

9451 THE SLIP CASTING OF TUNGSTEN. Barta, J.; Gorni, J. (Israel Ministry of Defence, Tel Aviv). Planseeber. Pulvermet., 13: 90-9(Aug. 1965).

A satisfactory suspension for slip casting of tungsten was developed. The optimum conditions were determined to be: vehicle-aqueous solution, 2.5% polyvinyl alcohol, and 0.5% ammonium alginate; tungsten-blended powders, 50% coarse, 31% medium, and 19% fine; vehicle/tungsten ratio, 1.5 (vol/vol); and electrolyte, ammonia. The effects of the particle size distribution of the tungsten powder, the pH, and the vehicle/tungsten ratio on the viscosity of the suspensions were investigated. Titration curves of the tungsten powders showed that the powders are acidic in character (due to an oxide layer) and that there are marked differences between nominally identical powders. Purification of the tungsten powders by heating them in hydrogen, caused a reduction in the amount of oxide layer and changed the characteristics of the suspensions. (auth)

9452 HOT PRESSING OF MOLYBDENUM POWDER. Heckel, R. W. (E. I. duPont de Nemours and Co., Inc., Wilmington, Del.). Trans. Met. Soc. AIME, 233: 2113-19 (Dec. 1965).

The densification of molybdenum powder by hot pressing was studied as a function of time (up to about 3×10^4 sec) at pressures of 5000, 15,000, and 30,000 psi in the temperature range from 700 to 1200°C. Equations relating density to pressure, time, and viscosity are presented. (M.C.G.)

9453 EXPERIENCES FROM THE ESTABLISHMENT OF THE TECHNOLOGICAL PROCESS FOR REACTOR GRAPHITE PRODUCTION FROM PETROLEUM COKE. Secerov, Mileta; Milicic, Miodrag (Center for Nuclear Raw Materials, Belgrade). 22p. (In Polish). (CONF-207-21). ORINS.

From Second Yugoslavian Polish Symposium on Uranium Technology and Metallurgy, Zakopane, Poland, Sept. 1963.

Tests showed domestic raw materials and auxiliary substances can be utilized for the production of reactor graphite from petroleum coke. The green mass used consisted of 67.7% petroleum coke, 0 to 0.2 mm; 22.3% tar; and 10% soot. The baking and graphitizing conditions were established for securing an apparent block density above 1.7 g/cm³. Tests showed that by using the domestic sodium fluoride during the purification a boron content below 0.2 ppM within the graphite blocks can be achieved. (JPRS)

9454 MICROSTRUCTURAL CHANGES DURING URANIUM DIOXIDE SINTERING IN ARGON ATMOSPHERE. Petrovic, V.; Kostic, E. (Inst. for Nuclear Sciences Boris Kidric, Vinca, Yugoslovia). 24p. (In Polish). (CONF-207-18). ORINS.

From Second Yugoslavian Polish Symposium on Uranium Technology and Metallurgy, Zakopane, Poland, Sept. 1963.

The results of certain microstructural investigations of uranium dioxide sintering in argon atmosphere are presented. Observations of unfinished, polished, and chemically etched surfaces showed the progress of sintering with temperature and time. Results show that the microstructure changes from heterogenous to homogenous, and that these changes do not depend on the density of the sintered uranium dioxide. (JPRS)

9455 EXPERIENCES WITH URANIUM ROD MELTING AND CASTING. Obradovic, Nenad (Center for Nuclear Raw Materials, Belgrade). 14p. (In Polish). (CONF-207-16). ORINS.

From Second Yugoslavian Polish Symposium on Uranium Technology and Metallurgy, Zakopane, Poland, Sept. 1963.

The influence of the kind and method of coating on the content of nonmetallic impurities in uranium was investigated. According to the tests, the best protection was produced by $MgZrO_3$ ceramic coating. Procedures for injection casting of uranium rods and tubes for special purposes were developed. (JPRS)

9456 FABRICATION OF SMALL URANIUM CARBIDE SPHERES. Shennan, J. B.; Nichols, M. J. (Reactor Fuel-Element Lab., Salwick, Eng.). pp 518-39 of Carbides in Nuclear Energy. Vol. 2. Russell, L. E. (ed.). London, Macmillan and Co., Ltd., 1964.

A process is described for the preparation of kilogram quantities of dense spherical particles of uranium carbide for use in dispersion fuels. The process, which is based on the carbon reduction of UO_2, consists essentially of two steps; first the formation of spherical green granules of UO_2–C mixture and second, the reaction and sintering of green spheres to give a U–C with the requisite properties. The UO_2–C green spheres are formed by gyrating, in a

bowl, a mixture of the powdered constituents in the requisite proportions to yield a particular composition in the range UC to UC_2. By the continual addition of the powder mixture to the bowl during granulation the UO_2–C spheres can be grown to any specific size in the range 200–2000 μ in batches up to 10 kg. The effects of particle size, agglomerate size, bed depth and binder content on the growth efficiency of these spheres was investigated. The second stage, which involves the reaction and sintering of the green spheres, is carried out in vacuum and requires a high pumping speed. With equipment meeting this requirement 5 kg batches were made although the material is dispersed in a number of molybdenum boats each containing only 150 g. Reaction and sintering were carried out in the temperature range 1350–1700°C, the final density, 9.5-12.5 g/cm^3, being controlled by the temperature. In the absence of UO_2, as determined by x-ray diffraction and metallography, the oxygen content of the final product appears to decrease with increasing carbon content, but does not greatly affect the bulk density or appearance of the spheres. (auth)

9457 DEVELOPMENT OF MIXED CARBIDE FUEL PREPARATION AND FABRICATION ROUTES AT DERE. Horspool, J. M. (Dounreay Experimental Reactor Establishment, Caithness, Scotland); Mowat, J. A. S.; Pickles, S. pp 572-87 of Carbides in Nuclear Energy. Vol. 2. Russell, L. E. (ed.). London, Macmillan and Co., Ltd., 1964.

$(U_{0.85}Pu_{0.15})$-carbides were prepared by reduction of the mixed oxides with C, under vacuum, at high temperatures and by arc-melting to buttons either the elements or the products of the oxide-carbon reduction. Losses of Pu by volatilization are suspected in both routes, and estimates are made of their magnitude. The product of reduction was also used to make sintered pellets, after ball milling, adding 1% paraffin wax as binder, and cold pressing. Minimum sintering temperatures were about 1550°C in vacuum, as well as in Ar, and densities up to 12.95 g/cm^3 were achieved. The effects of time and temperature of sintering, of materials of different contents, and of green pressed densities were studied; one of the most important variables is the exient to which ball milled powder becomes oxidized by trace impurities in the Ar atmosphere. Control of C content to a chosen value is near the limits of analytical precision. (auth)

9458 THE SINTERING BEHAVIOR OF URANIUM CARBIDE. McLaren, J. R. (Atomic Energy Research Establishment, Harwell, Eng.); Regan, M. C.; Hedger, H. J. pp 588-614 of Carbides in Nuclear Energy. Vol. 2. Russell, L. E. (ed.). London, Macmillan and Co., Ltd., 1964. (AERE-R-4486).

The factors affecting the sintering behavior of fine uranium carbide powders were studied in detail and attention is drawn to the importance of particle size and the sintering atmosphere. As a result of this research uranium carbide can be sintered consistently to densities of 95–97% of theoretical at reasonable temperatures. The carbide was milled and handled in Ar generally containing up to 10 ppm O_2, 10 ppm H_2O and 200 ppm N_2. This purity of atmosphere is necessary to minimize the O_2 contamination of the carbide powders as their particle size is reduced, since contaminated powders do not sinter so well. Milling times of about 50 hrs dry or 10 hrs wetted with xylene in a tungsten carbide mill provided the necessary degree of fineness for sintering arc-melted or C reduced oxide feed material to the above densities in 2 hrs at 1550°C. Precompaction and die-wall lubrication assisted in producing strong and fault-free compacts from these powders at pressures of ~30 tsi. From isothermal heating experiments on batches of powder treated as described above an activation energy of 122 ± 5 kcals was obtained for the sintering process. Changes in the composition of the carbide during the fabrication process depended partly upon the method of milling. The dry milled product showed an increase in O_2 content while C and N_2 contents stayed sensibly constant and final sintered analyses of 4.8 wt % C, ~ 0.1 wt % O_2 and ~500 ppm N_2 were obtained starting from material with ~200 ppm O_2. Wet milling in xylene resulted in lower O_2 contamination but linear increase in C content occurs with milling time due to cracking of adsorbed xylene, together with W contamination from the mill; final analyses of 4.8 wt % + 0.02 wt %/hr C ~0.07 wt % O_2 ~250 ppm N_2 and ~0.12 wt %/hr W were obtained on sintered pellets in this case. (auth)

9459 THE EFFECT OF OXYGEN ON THE SINTERING OF U–C AND $(U_{0.85}Pu_{0.15})C$. Potter, P. E. (Atomic Energy Research Establishment, Harwell, Eng.). pp 615-28 of Carbides in Nuclear Energy. Vol. 2. Russell, L. E. (ed.). London, Macmillan and Co., Ltd., 1964.

The reactions of U–C and $(U_{0.85}Pu_{0.15})C$ powders, of particle size 1-5μ, with air and water vapor were studied by following the changes in weight which accompany these reactions. When compacts, which were prepared from partially reacted powders, are sintered at 1550°C in flowing Ar lower densities are obtained with these powders as compared with compacts pressed from unexposed powders. The relation between sintered density and the O_2 contents of hyper and hypostoichiometric carbides are described and the weight loss on sintering was correlated with the initial O_2 content of the powders and the losses of C and O_2 during sintering. (auth)

9460 FABRICATION OF URANIUM MONOCARBIDE WITH A VOLATILE SINTERING TEMPERATURE DEPRESSANT. Hammond, J. P. (Oak Ridge National Lab., Tenn.); Adamson, G. M. Jr. pp 648-67 of Carbides in Nuclear Energy. Vol. 2. Russell, L. E. (ed.). London, Macmillan and Co., Ltd., 1964.

To alleviate the problems in solid state sintering of UC, a process was developed in which 5 to 10 wt % UAl_2 is used as a removable sintering aid. Using powders prepared from arc-melted and cast ingots of UC and UAl_2, structures free of secondary constituents and with densities above 97% of theoretical were achieved routinely by vacuum sintering at only 1350 to 1400°C. The Al of the UAl_2 is volatilized during sintering while the U from this compound combines with C from the graphite containment crucible. Poor Al removal and poor densification resulted from using hyperstoichiometric UC as the charge to provide extra C to combine with this U. Investigation of the mechanism of sintering revealed that UC and UAl_2 form a quasi-binary phase diagram of the simple eutectic type with no appreciable solid solubility between phases. The eutectic reaction (1540 ± 20°C at 12 wt % UC) occurred about 165°C above the optimum sintering temperature, a paradoxical feature for systems consolidating by liquid-phase sintering. The densification process was shown to consist of three stages: sintering activated by an Al vapor, liquid-phase sintering, and solid state sintering. By developing appropriate ternary isothermal phase diagrams, the liquefaction of the sintering aid (enabled by Al removal) and its final elimination were traced. Al vapor issuing during the early stage apparently abets sintering by scavenging the carbide grains of contaminating films and the furnace atmosphere of O_2, N_2 and/or H_2O. The isothermal diagrams also revealed that excess C in the UC charge restrains Al removal and densification by preventing the formation of a completely liquid binder phase. (auth)

9461 SINTERING CHARACTERISTICS OF U–C AND (UPu)–C WITH, AND WITHOUT, SMALL ADDITIONS OF NICKEL. Taylor, K. M. (Carborundum Co., Niagara Falls, New York); McMurtry, C. H.; Andersen, J. C. pp 668-79 of Carbides in Nuclear Energy. Vol. 2. Russell, L. E. (ed.). London, Macmillan and Co., Ltd., 1964.

A comparison was made of the sintering characteristics of U–C and (UPu)–C powders with and without Ni sintering aid. With 0.1-0.2 wt % additions of Ni a minimum final density of 95% theoretical density was consistently obtained, even with considerable variation in powder characteristics and sintering conditions. Without sintering aid, results were erratic. Comparison was made also of the microstructure and phase composition of pellets sintered with and without Ni. Effects of annealing the pellets under various conditions are reported. (auth)

9462 VACUUM SINTERING OF URANIUM–PLUTONIUM CARBIDES. Harder, B. R. (Atomic Energy Research Establishment, Harwell, Eng.); Sowden, R. G.

pp 680-92 of Carbides in Nuclear Energy. Vol. 2. Russell, L. E. (ed.). London, Macmillan and Co., Ltd., 1964.

Studies were made of the vacuum sintering of (UPu)–C prepared by reduction of oxides with C. The method affords a rapid and reproducible means of preparing dense sintered pellets. Carbides containing more than 25% Pu can be sintered to densities greater than 97% theoretical density without the addition of a sintering aid. A high level of O_2 increases the open porosity, but the situation can be restored by the addition of small amounts of Ni (0.2-0.5 wt %) to the carbide powder. At a lower level of Pu (15%) the addition of Ni is always necessary to obtain densities greater than 95% theoretical density. Ni suppresses the formation of CO during sintering, and is effective over a wide range of O_2 and C contents. (auth)

9463 MELTING AND CASTING OF URANIUM CARBIDE. Brown, D. J. (International Research and Development Co. Ltd., Newcastle-upon-Tyne, Eng.). pp 711-22 of Carbides in Nuclear Energy. Vol. 2. Russell, L. E. (ed.). London, Macmillan and Co., Ltd., 1964.

Uranium carbide was prepared by direct reaction of U and C in an arc furnace and by reduction of UO_2 with C at 1600°C in a dynamic vacuum. Ingots 0.1 to 0.3, 0.1 to 0.5, and 0.1 to 0.75 in. dia were skull-cast from crucibles of 250, 1000 and 2500 g capacity respectively. These ingots had C contents within ±0.15 wt % of nominal and N_2 contents generally below 200 ppm. Freedom from center-line porosity was achieved by using tapered wall graphite molds which are direct resistance heated. Thermal shock cracking due to rapid cooling in the mold was eliminated by the use of suitably thin mold walls. Some interdendritic porosity remained in hypostoichiometric material. Stages in the development of the present route are described. Details of radiographic exposures using ^{192}Ir are included. (auth)

9464 INDUSTRIAL CASTING OF URANIUM CARBIDE. Porneuf, A. (Compagnie Industrielle des Combustibles Atomiques Frittes, Orsay, France). pp 723-35 of Carbides in Nuclear Energy. Vol. 2. Russell, L. E. (ed.). London, Macmillan and Co., Ltd., 1964.

A process recently developed for the fabrication of dense uranium carbide fuel is described and the techniques used for melting and casting uranium carbide under vacuum are discussed. The new process for melting and casting this material uses a completely automatic casting technique. The experience gained from using this process by which it was possible to produce a batch of two tons of dense uranium carbide is outlined. (auth)

9465 FABRICATION OF CAST URANIUM CARBIDE RODS. Himmelstein, P. (Nuklear-Chemie und Metallurgie GmbH., Wolfgang, Ger.); Liebmann, B.; Schaefer, L. pp 736-44 of Carbides in Nuclear Energy. Vol. 2. Russell, L. E. (ed.). London, Macmillan and Co., Ltd., 1964.

A production facility for the fabrication of cast UC rods was constructed. The production cycle consists of the following stages: UO_2 and graphite are mixed. The mixture is pressed into pellets with a green density of about 4.5 g/cm^3. The green pellets are reacted in a semi-continuous vacuum furnace to form the carbide. The reaction rate is about 3 kg/hr. The reacted pellets have a density of about 8-9 g/cm^3. The reacted pellets are melted and cast in a skull melting furnace. In this furnace about 50 kg of UC can be produced per day. The castings are cut, ground, and degreased. The degreased rods are inspected, to check their dimensions and density, and made ready for shipment. (auth)

9466 SKULL MELTING AND CENTRIFUGAL CASTING EXPERIMENTS ON MONOCARBIDE PRODUCED BY THE CARBOTHERMIC REDUCTION OF URANIUM OXIDE. North, J. M. (Atomic Energy Research Establishment, Harwell, Eng.). pp 745-51 of Carbides in Nuclear Energy. Vol. 2. Russell, L. E. (ed.). London, Macmillan and Co., Ltd., 1964.

Skull melting experiments on UC prepared by carbothermic reduction of UO_2 were made. Trials, on batches of material with various residual O_2 contents, were made to see if this can be removed in the melting process, and if control of stoichiometry can be obtained. In order to produce larger amounts of small dia bar per cast than is possible by static casting methods, centrifugal casting techniques were developed. (auth)

9467 SOME ASPECTS OF THE FABRICATION OF URANIUM MONOCARBIDE BY ELECTRON BOMBARDMENT. Blum, P. (Centre d'Etudes Nucleaires de Grenoble, Isere, France); Devillard, J. pp 752-62 of Carbides in Nuclear Energy. Vol. 2. Russell, L. E. (ed.). London, Macmillan and Co., Ltd., 1964.

Several processes for the production of UC ingots by electron beam melting are compared. In the first method, the fusion of a UC rod is combined with a simultaneous die-casting operation. The rods can be prepared in two different ways, either by reaction sintering or by electron-beam melting. A second procedure results in the direct die-casting of melted carbide particles prepared by carbothermic reduction or reaction sintering. Observations made during these die-casting operations are discussed with respect to the casting technique and the purity of the finished material. A subsequent fabrication process is considered, which is based on changes in composition during the electron bombardment. Finally, a technological device for the production of relatively small ingots is described. (auth)

9468 BONDING OF UC AND UC-IRON CERMETS TO CANNING MATERIALS. Paris, R. (Atomic Energy Research Establishment, Harwell, Eng.); McLean-Elrick, A.; Davies, J. M.; French, P. M. pp 777-800 of Carbides in Nuclear Energy. Vol. 2. Russell, L. E. (ed.). London, Macmillan and Co., Ltd., 1964. (AERE-R-4511).

Attempts were made to bond UC and UC–Fe cermets to various canning materials including stainless steel, ferritic steel, Mo, Nb, and V. The techniques used involved either direct reaction bonding or the use of an intermediate barrier; the direct reaction bonding was tested on samples prepared by either hot loading, cold loading, or gas pressure bonding and intermediate barriers were provided by brazing with Cu and Cu-base alloys or gas pressure bonding with a Cu interlayer. The gas pressure bonding technique was used on both UC powder and massive UC and the effect of variables on the bonding and density of the UC is discussed. The examination of the bonds produced by the various methods with particular reference to circumferential cracking is described. Results of thermal cycling tests on bonded specimens showed that cracking may develop in initially satisfactory bonds. (auth)

9469 THE COATING OF URANIUM DICARBIDE PARTICLES IN A FLUIDIZED BED. Carley-Macauly, K. W. (Atomic Energy Research Establishment, Harwell, Eng.); Myles, J. W.; Williams, G. H. pp 826-48 of Carbides in Nuclear Energy. Vol. 2. Russell, L. E. (ed.). London, Macmillan and Co., Ltd., 1964.

The deposition of C and SiC coatings of varying thicknesses up to 100 μ, on UC_2 particles of about 200–400 μ dia is described. The coating was carried out in graphite vessels using a fluidization technique at temperatures between 1000 and 2000°C; developments are described in the design of these vessels for an increasing scale of operation. The structure and retention properties of the coatings were examined. It is concluded that preparation can be conducted on a reasonable scale in a fluidized bed reactor to make coatings which are effective as produced. Available in-pile tests on coated particles indicate that substantial retention of fission products may be maintained up to 1200–1300°C in-pile, in spite of considerable damage to the coatings. (auth)

9470 STARTUP EXPERIENCE WITH THE EBR-II FUEL CYCLE FACILITY. III. FUEL FABRICATION. Feldman, M. J.; Bacca, J. P.; Eschen, V. G.; Mahagin, D. E. (Argonne National Lab., Idaho Falls, Idaho). pp 14-18 of Proceedings of the 13th Conference on Remote

Systems Technology, 1965. Hinsdale, Ill., American Nuclear Society, 1965.

Remote fabrication of EBR-II fuel was accomplished in the Fuel Cycle Facility. Start-up and experience indicated that individual fabrication operations must be carefully integrated and balanced in order to affect a continuous process flow. In order to achieve this goal, design modifications were made to much of the fabrication equipment, and operator manual assistance was incorporated into operations by utilization of sealed-type master-slave manipulators. (auth)

9471 MODIFICATION OF THE KAPL REMOTE ANNEALING FACILITY. Altamari, L. A. (Knolls Atomic Power Lab., Schenectady, N. Y.). pp 126-8 of Proceedings of the 13th Conference on Remote Systems Technology, 1965. Hinsdale, Ill., American Nuclear Society, 1965.

The remote annealing facility at KAPL was modified to increase the number of specimens processed. The number of in-cell furnaces was increased and the gas collection system was automated. Equipment operation was satisfactory, with transient annealing conducted during normal working hours and long term annealed specimens monitored during off-shift hours. (auth)

9472 A REMOTE ULTRASONIC GRINDING SYSTEM. Bohm, P. A.; Kaznoff, A. I. (General Electric Co., Pleasanton, Calif.). pp 164-5 of Proceedings of the 13th Conference on Remote Systems Technology, 1965. Hinsdale, Ill., American Nuclear Society, 1965.

An ultrasonic grinding system was developed to remotely machine samples of irradiated ceramic fuels. It can also be used to accurately machine other hard and brittle radioactive materials. The major components are: an in-cell ultrasonic head and cutting tool, an in-cell motor-driven triaxial positioning stage, standard master-slave manipulators, an optical system consisting of two mirrors and a telescope, and an out-of-cell console for control of the ultrasonic head and positioning stage motors. (M.C.G.)

9473 CUTTING MACHINE FOR IRRADIATED PIPES. Junger, J. M.; Bonnet, G. (European Atomic Energy Community Joint Research Center, Ispra, Italy). pp 195-7 of Proceedings of the 13th Conference on Remote Systems Technology, 1965. Hinsdale, Ill., American Nuclear Society, 1965.

A machine was developed for cutting a set of concentric pipes. It was designed especially to work in radioactive zones. The cutting tool cuts in a horizontal plane. The pipes to be cut are held vertically between remotely operated self-centering pneumatic jaws. The four cutters are mounted in a gear-driven system. (M.C.G.)

9474 IMPROVEMENTS IN OR RELATING TO CERAMICS. (to General Dynamics Corp.). British Patent 1,010,385. Nov. 17, 1965. Priority date Apr. 11, 1962, United States.

A method of preparing improved radiation-resistant ceramic products suitable for ceramic moderators for nuclear reactors consists of combining in particulate form a refractory oxide, particularly beryllia, and a glass-forming sintering agent and subjecting the mixture to a cold pressing forming operation. After forming, the article is sintered to produce a glassy phase between the refractory oxide particles in the product. (B.L.M.)

9475 METHOD OF MANUFACTURING CONTROL RODS FOR NUCLEAR REACTORS. (to Allmanna Svenska Elektriska Aktiebolaget). British Patent 1,010,607. Nov. 24, 1965. Priority date Sept. 11, 1961, Sweden.

A method is described for producing a control rod by cladding an element of a neutron absorbing material, an alloy of Ag with one or both of the metals Cd and In, with a layer of steel. The steel cladding may be applied only to the surfaces of the element subjected to mechanical and chemical stresses. The steel layer with a thin layer of Cu attached to it is applied to the element of neutron absorbing material with the Cu layer turned towards the element, and the element and the steel layer are subjected to heat treatment at a temperature of at least 500°C but not above the melting point of the neutron absorbing material. A thin layer of Ni may be arranged between the Cu and steel layers. The Ni layer is applied electrolytically or chemically to the surface of the steel layer turned towards the element, and the Cu layer is applied in the same manner to either the Ni or steel layer surfaces turned towards the element. The Cu and Ni layers have a thickness of approximately 5 μ. (B.L.M.)

9476 IMPROVEMENTS IN OR RELATING TO FUEL MATERIALS FOR NUCLEAR REACTORS. Norreys, John Jephson (to The General Electric Co. Ltd.). British Patent 1,011,053. Nov. 24, 1965. Filed Nov. 7, 1963.

A fuel material for a reactor consists substantially of UC having a composition in the range of 50% U:50% C to 48% U:52% in atomic percentages and W in the proportion in the range of 0.05 to 5.0 wt %. The fuel is prepared by melting a powdered mixture of the constituents and casting the melt to form a body of a desired shape and size. The W can be introduced in the form of large pieces or a W electrode can be used for the arc melting of the uranium-carbon mixture or the uranium carbide. (B.L.M.)

9477 IMPROVEMENTS IN OR RELATING TO NUCLEAR FUEL MATERIALS. Jaques, Thomas Arthur John; Sturge, Derek William James (to United Kingdom Atomic Energy Authority). British Patent 1,011,348. Nov. 24, 1965. Filed Oct. 28, 1963.

A process is reported for the preparation of nuclear fuel particles having a hollow center bounded by a wall of a refractory composition including fissile and/or fertile material dispersed in the refractory material. The wall is enclosed by a fission product retaining layer of pyrolytic carbon. The process includes forming a particle containing a carbide of thorium or uranium or mixtures of these, applying to the particle a coating of a refractory substance that has a higher melting point than the fuel carbide and that is capable of accepting into its interstices at least a proportion of the nuclear fuel carbide, and heating the particle to a temperature above the melting point of the carbide but below that of the coating. (B.L.M.)

9478 IMPROVEMENTS IN AND RELATING TO THE MANUFACTURE OF CERMETS WITH METAL MEMBERS BONDED THERETO. Arthur, George (to United Kingdom Atomic Energy Authority). British Patent 1,012,162. Dec. 8, 1965. May 1, 1961.

A body comprising a cermet core with an enclosing metal container bonded to it is formed by pressing mixed ceramic and metal powders into a compacted mass, coating with metal powder suspended in an adhesive liquid, sintering the coated mass at a temperature below that at which any melting will take place, inserting the sintered mass in a metal container, and hot swaging the assembly at a temperature in the range of 700°C up to a temperature not exceeding a value at which melting takes place so as to bond the metal container to the sintered mass. The swaging operation also brings about a reduction of section accompanied by densification of the mass constituting the cermet core. The process is applicable to the fabrication of reactor fuel elements in which a cermet fuel rod consisting of a ceramic nuclear fuel in a metal matrix is enclosed and bonded to a metal container. (B.L.M.)

9479 REFRACTORY ARTICLES AND METHOD OF THEIR MANUFACTURE. (to Valley Co. Inc.). British Patent 1,012,269. Dec. 8, 1965. Priority date Nov. 22, 1960, United States.

A process is provided for infiltrating with a molten metal or metal alloy a permeable framework consisting of at least one of the elements C, B, or Si to yield a refractory of a desired metallic carbide, boride, or silicide that contains at least one hard phase of high melting point. After machining or other preliminary treatment of the article, the article is heated in a protective atmosphere or in a vacuum furnace to cause the infiltrated metal to react with the framework to produce the desired refractory article. (B.L.M.)

9480 PREPARATION OF HIGH-DENSITY NUCLEAR FUEL. Abe, Mitsunobu (to NGK Insulators, Ltd.). Japanese Patent 1964-9550. June 4, 1964. Filed Oct. 11, 1961.

A very high density nuclear fuel (more than 99% theoretical density) is obtained by mixing 99.99 to 4 wt % UO_2 or ThO_2 powder (or a mixture of the two), 0 to 95.99 wt % BeO, and 0.01 to 5 wt % Be and hot pressing the mixture at 1300 to 1800°C and 100 to 300 Kg/cm^2 under a reducing or inert atmosphere. (NSA of Japan)

9481 METHOD FOR PRODUCING RADIATION SHIELDING MATERIALS. Ichikawa, Wataru (to Asahi Glass Co., Ltd.). Japanese Patent 1964-14094. July 20, 1964. Filed Mar. 26, 1962.

The method proposed for the production of radiation shields of any desired shapes comprises the curing with a curing catalyst of a glass fiber-reinforced polyester resin of which powder of iodides of heavy metals, especially Cw or Pb, have been added. Pigments or other additives may be added if necessary. The shielding power of the shields thus obtained is at least twice that of shields in which an equal amount of lead is used. (TCO)

9482 METHOD OF WORKING A MATERIAL BY AN ELECTRON BEAM. Okazaki, Ikio (to Japan Electron Optics Lab., Co., Ltd.). Japanese Patent 1964-14590. July 24, 1964. Filed July 12, 1962.

A method proposed for working a material by a electron beam of suitable intensity is particularly useful in making precise small holes or grooves in or on thin plates. The material to be worked is placed on a base; covered partly or entirely with an insulated material, e.g., a crystal plate, and irradiated with an electron beam. The beam is directed onto the plate from above, and a perforation is made in the plate where the largest or center current of the beam is applied. The material under the plate is not heated by the skirt part of the beam, and the beam is focused satisfactorily onto the material by the negative charge accumulated around the hole already perforated in the cover material. (NSA of Japan)

9483 FABRICATION OF CONTROL ROD. Morita, Takahiro (to Hitachi, Ltd.). Japanese Patent 1964-23451. Oct. 21, 1964. Filed Sept. 22, 1961.

In the proposed method for fabrication of a control rod, a powder mixture of aluminum and a neutron absorber such as B_4C is pressed into a desired plate. The plate is wrapped in aluminum foil and placed in an aluminum case. The opening of the case is closed by pouring in molten aluminum. The plate thus clad with aluminum is rolled for final shaping and for bonding of plate and cladding material. (A.G.W.)

Properties and Structure

See also CHEMISTRY — Inorganic and Physical Chemistry
PHYSICS — Solid State Physics

Refer also to abstracts 9091, 9421, and 10377.

9484 (AD-620526) PILOT PRODUCTION AND EVALUATION OF TANTALUM ALLOY SHEET. Quarterly Report No. 11, March 15, 1965–June 15, 1965. Ammon, R. L.; Filippi, A. M.; Goodspeed, R. C. (Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.). Aug. 15, 1965. Contract NOw-64-0394-d. 21p. (WANL-PR-M-013). CFSTI $1.00 cy, $0.50 mn.

Eighteen and twenty-four in. wide T-222 sheet was obtained by rolling slabs produced by direct forging 4-in. dia ingots. One sheet was sampled for detailed chemical analysis and mechanical property studies. Although the investigations are not yet complete, initial recrystallization results show a behavior analogous to that described for T-222 sheet produced for smaller ingots. Size and shape of second phases occurring in solution treated and aged T-222 samples were studied by means of electron microscopy. The dimetal carbide occurring upon aging at 2000°F principally grows as a platelet several thousand angstroms in thickness. The monocarbide developed upon aging at 2800°F appears as a very fine dispersoid submicron in size. (auth)

9485 (AD-623567) ELECTRON MICROSCOPE FRACTURE EXAMINATION TO CHARACTERIZE AND IDENTIFY MODES OF FRACTURE. Beachem, C. D. (Naval Research Lab., Washington, D. C.). Apr. 19, 1965. 124p. (NRL-6293; AFML-TR-64-408). CFSTI $4.00 cy, $0.75 mn.

The fine-scale fracture topographies of both monotonic and fatigue fracture surfaces of several steels and aluminum and titanium alloys were characterized. Some effects of orientation of specimen upon the fatigue crack surface appearance in 2024 T851 were found. Quasi-cleavage in hydrogen embrittled, 250,000 psi yield strength, maraging steel was discovered. Four overload fracture modes, including a previously unreported mode, were found in a 7075 T6 aluminum alloy by precision matching techniques. A number of failure analyses were made. (auth)

9486 (BAW-3376-4) IRRADIATION PERFORMANCE OF THORIA–URANIA FUEL MATERIALS. Final Report. (Babcock and Wilcox Co., Lynchburg, Va.). Sept. 1965. Contract AT(30-1)-3376. 279p. Dep. mn; CFSTI $6.00 cy, $1.50 mn.

The permeability coefficient of compacted ThO_2-UO_2 fuel specimens was measured from room temperature to 600°C. The gas flow was identified as a combination of Knudsen and viscous flow. Thermal transpiration varied as a function of pressure, decreasing to a low value of above-atmospheric pressures. The sorbed gas release from sol-gel ThO_2-UO_2 fuels, containing to 10% UO_2, increased with increasing UO_2 content. The gas released from the sol-gel fuel varied from a minimum of 0.002 cc/gm for coarse particles to a maximum of 6.1 cc/gm for pulverized materials. The gas released from the fuels consisted of Ar, CO, CO_2, H_2, CH_2, N_2, O_2, and water vapor. A device for simulating a temperature gradient in an operating fuel rod for thermal conductivity measurements was assembled and operated successfully. Post-test examinations of the specimens revealed altered grain structures, simulating those observed in specimens after irradiation at high power. The thermal conductivities measured for UO_2 and ThO_2-UO_2 agree well with published data for a temperature range of 800 to 1800°C. Isothermal grain-growth studies of 2 and 10% UO_2 in ThO_2 resulted in consistent grain growth as a function of temperature for the 2% material. After prolonged exposure (16 hrs) at 2227°C, the ThO_2-10 UO_2 apparently underwent recrystallization. The design concepts for in-reactor measurements of the irradiated fuel thermal conductivity and of the static and dynamic fission gas release are described. (W.L.G.)

9487 (BNWL-166, pp 3.1-9) PLUTONIUM PHYSICAL METALLURGY. Bowman, F. E.; Kissinger, H. E.; Mastel, B.; Nelson, R. D. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

The effect of applied uniaxial tensile and compressive stresses on the temperature for the start of the $\beta \rightarrow \alpha$ transformation was established and explained on the basis of a martensitic type transformation. Evidence that deformed α-Pu does anneal at 105°C was obtained from subsequent $\alpha \rightarrow \beta$ transformation rates; it was established that transformation rates decrease with annealing. The temperature dependence of the creep of β-Pu, both β formed from α and β formed from γ, was determined at compressive stresses up to 10,000 psi. The creep activation energies for β_γ are 10 to 20% higher than the corresponding values for β_α at 7500 and 10,000 psi. Deterioration in the rolling behavior of ingots of electrorefined Pu during a one yr storage period in vacuum was attributed to cracking; the effect of He generation and accumulation on deterioration was therefore masked. The texture of α-Pu rolled in the α-phase was studied by x-ray diffraction techniques. Recent results and their interpretation cast considerable doubt on the validity of a [020] texture. (auth)

9488 (BNWL–166, pp 4.8-11) WELD ZONE FRACTURE TOUGHNESS DETERMINATIONS. Hoagland, R. G.; Rowe, R. G. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Tests were performed to determine the fracture toughness of welded ASTM A302-B steel. Double cantilever beam (DCB) specimens were machined from the mid-thickness of a 1 in. plate containing a double bevel butt weld. The length of the DCB specimen was oriented perpendicular to the weld. After welding and machining, the specimens were austenitized at 1750°F for ½ hr and water quenched. Fracture toughness determinations were made at room temperature. These tests indicate that the welded zone is tougher than the base metal, with a peak of maximum toughness in the filler metal, a saddle point immediately adjacent to it, and another toughness maximum in the heat affected zone. The toughness then slowly decreases to a constant value in the base metal. The hardness profile shows correspondence with the maximum toughness region in the filler metal, but there is no hardness drop in the heat affected zone to correspond with the second maximum. This points out that the fracture toughness is not directly related to the hardness, but is more sensitive to the microstructure of the material. A second specimen, which was stress relieved at 600°C for ½ hr, had a similar toughness profile. It was seen that the heat treatment had less effect upon the toughness in the heat affected zone than that of the weld zone. The stress relieved sample had a generally higher fracture toughness. The nature of the fracture toughness profile obtained indicates that three factors affecting the toughness are: the grain size, the amount of stable carbide precipitation, and the phases present in the microstructure. These preliminary tests demonstrate the usefulness of the DCB specimen in examining the fracture toughness of a welded material. With a single DCB specimen it is possible to determine the entire toughness profile across the weld. The effect of various heat treatments can readily be observed due to: the sensitivity of the method to changes in the microstructure, and the ease with which the tests may be performed. (auth)

9489 (BNWL–166, pp 6.9-14) N-REACTOR. Aungst, R. C. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

A reproducible drop-weight test was developed to determine the nil ductility transition (NDT) temperature of Zircaloy-2 pressure tubing using specimens cut from the tube wall. The principle of the test is similar to that of the standard drop-weight test for steel. Results show a dependence of the NDT on hydrogen content of the specimen. Results of fracture tests on slotted tube specimens covering a wide range of temperatures were used to construct a fracture analysis diagram. Failure occurs for a given defect size at the same fraction of yield strength for all temperatures from below the NDT to above the crack arrest temperature. This behavior differs from that of steel plate in that the latter exhibits a marked rise in failure stress at temperatures above the NDT. (auth)

9490 (BNWL–166, pp 6.15-18) USA-AECL COOPERATIVE PROGRAM. Pankaskie, P. J. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Crack propagation of hydrided Zr – 2.5 wt % Nb alloy appears to be somewhat erratic as compared to Zircaloy-2. Tensile tests reveal little or no effect of varying strain rate at 23 and 300°C. A small effect is observed at 400°C. (auth)

9491 (CEA-R–2740) APPLICATIONS DES MESURES DE RESISTIVITE ELECTRIQUE A L'ETUDE DE LA PURIFICATION DE L'URANIUM PAR FUSION DE ZONE FLOTTANTE PAR BOMBARDEMENT ELECTRONIQUE [Theses]. (Applications of Electrical Resistivity Measurements to Research into the Purification of Uranium Using Floating Zone Melting by Electronic Bombardment [Thesis]). Pascal, Jacques Lucien (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1965. 68p. Dep. mn.

Submitted to Paris Univ. (France). Faculte des Sciences.

Uranium was purified by zone melting. Because of the high affinity of uranium towards elements such as oxygen, contamination was avoided by adopting the floating zone technique and by working under high vacuum. The difficulties created by deformation of uranium rod, which are caused by anisotropy of dilation of phases α and β and allotropic transformations $\alpha \rightleftharpoons \beta$ and $\beta \rightleftharpoons \alpha$, were overcome by the use of electron bombardment stabilized by feedback. A rough control of the purification was obtained by micrographic examination, microhardness measurements, and secondary recrystallization tests. Electrical resistivity measurements at 20°K determined the degree of purity. (auth)

9492 (JPL-TR–32-818) SLIP IN TUNGSTEN AT HIGH TEMPERATURES. Taylor, Jack L. (Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.). Oct. 15, 1965. Contract NAS-7-100. 12p.

Single crystals of tungsten grown from powder-metallurgy swaged rod by high temperature annealing were deformed in tension at temperatures from 2500 to 5000°F. Orientation of specimen tensile axis, strained matrix, and deformation bands was determined optically by reflections from {110} etch pits. Slip traces were analyzed and slip direction determined. Results indicate that {110}⟨111⟩, {112}⟨111⟩, and {123}⟨111⟩ type slip occur in tungsten over the temperature range investigated. Slip is orientation dependent occurring on that combination of slip plane and direction which has the highest critical resolved shear stress. Overshooting appears to be a general occurrence between 2500 and 5000°F. Deformation bands show rotation in a direction opposite to the rotation of the tensile axis. (auth)

9493 (JPL-TR–32-827) TENSILE BEHAVIOR OF SAME-LOT SINGLE-CRYSTAL AND POLYCRYSTALLINE TUNGSTEN FROM 2500 TO 5000 deg F. Taylor, Jack L. (Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena). Nov. 15, 1965. Contract NAS7-100. 18p.

The tensile properties of single-crystal tungsten produced by annealing commercial type-MK powder-metallurgy rod at 5150°F were studied at a nominal strain rate of 0.02/min as a function of orientation and temperature (2500 to 5000°F). A preferred orientation was exhibited by the crystals, the tensile axes of over 75% of them being oriented between ≃10 and ≃30° from the [001] corner of the unit triangle. Single crystals within ≃19° of the [001] corner, oriented for {112}⟨111⟩ and {123}⟨111⟩ family slip, were the strongest up to ≃4000°F and the most ductile at all temperatures in the test range. A minimum at ≃4000°F and a maximum at ≃4500°F occurred in curves of elongation vs temperature for single crystals whose orientations were in the region of {110}⟨111⟩ family slip ≃20 to ≃30° from the [001] corner, a region in which over 50% of the single crystals were oriented. Little if any variation with orientation was observed in values of resolved yield stress, which ranged from 1000 ± 150 psi at 2500°F to 500 ± 50 psi at 500°F. Polycrystalline tungsten of the same lot and chemical composition as the single-crystal material also was tested under the same conditions of strain rate and temperature. The tensile results were consistent with previously reported results for other lots of polycrystalline powder-metallurgy tungsten, including a ductility minimum at ≃3500°F and a maximum at ≃4500°F. It appears that orientation may be a factor in the ductility minimum in polycrystalline tungsten, presuming that the many small crystals making up the core of the polycrystalline specimens exhibit the same preferred orientation as the single-crystal material. The maximum in elongation, which also occurs in both polycrystalline and single-crystal tungsten, may be similarly related through preferred orientation. Comparison of polycrystalline and single-crystal tungsten indicated an upper limit of ≃2 – 1 to the strengthening effect due to grain size at 2500°F and above. (auth)

9494 (LA-DC-6833) HYDROGEN EMBRITTLEMENT TESTS OF CRYOGENIC METALS. Mills, R. L.; Edeskuty, F. J. (Los Alamos Scientific Lab., Univ. of California, N. Mex.), [1963]. Contract W-7405-eng-36. 6p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

Nine materials were examined for the possible embrittling effect of hydrogen. These included the 6 aluminum alloys, 1100, 2024, 5052, 6061, 7039, and 7079; Invar-36; Ti-6 Al-4V; and mild carbon steel AISI-C1019. The results showed that with the exception of AISI-C1019, it is feasible to use any of the materials for liquid hydrogen service if it is remembered that several of them, notably Ti-6Al-4V and Al-2024 and 7079, can be initially extremely brittle. Even so, exposure to cathodic hydrogen apparently does not confer additional embrittlement. (P.C.H.)

9495 (NAA-SR-11191) METALLURGICAL STUDY OF NIOBIUM/TYPE 316 STAINLESS STEEL DUPLEX TUBING. Ferry, P. B.; Page, J. P. (Atomics International, Canoga Park, Calif.). Jan. 5, 1965. Contract AT-11-1-GEN-8. 32p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Tests were made to determine the basic feasibility of using Nb/type 316 stainless steel duplex tubing in mercury Rankine boilers. The use of this material was determined to be feasible as indicated by quality, bond strength, bond life, and lack of hydrogen embrittlement. (P.C.H.)

9496 (NCSC-2663-19) URANIUM INTERSTITIAL PHASES. Final Report. Stoops, R. F.; Hamme, J. V.; Sheffield, G. S. (North Carolina State Univ., Raleigh. Dept. of Engineering Research). Dec. 1964. Contract AT(40-1)-2663. 46p. (EURAEC-1531). Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Work Performed under United States-Euratom Joint Research and Development Program.

In research on the development of ceramic materials that would have unique advantages as nuclear fuel materials phase relationships in the systems U-C-O and U-C-O-N were studied. The results for U-C-O are presented in the form of a ternary diagram showing the phase relations in furnace-cooled specimens which had been reacted at 1800°C. A solid solution of oxygen in UC was found to exist, and when it was saturated with oxygen, it had the composition given by the formula $U(C_{0.75}O_{0.25})$ and a lattice parameter of 4.953 ± 0.001A. Stable interstitial phases of uranium were investigated in the system U-C-N-O. No U(C,N), U(C,N,O), or U(N,O) compound was found. It was established that a complete series of solid solutions exists between UN and UC and between UN and $U(C_{0.75}O_{0.25})$. The lattice parameters of these solid solutions deviate only slightly from Vegard's law. A procedure was developed so that $U(C_{0.75}O_{0.25})$ could be made with accurately controlled composition. Powders of this material were formed into dense specimens by hot pressing much more easily than were powders of UC under the conditions investigated. The results indicate that $U(C_{0.75}O_{0.25})$ has considerable potential as a clad nuclear fuel material. (P.C.H.)

9497 (NP-15725) DATA SHEETS FOR W-5Re-2.2ThO_2 ALLOY. (Battelle Memorial Inst., Columbus, Ohio). July 13, 1965. 7p.

Information is given on the fabrication and properties of W-5 Re-2.2 ThO_2 system. Sheet of the alloy is characterized by a high recrystallization temperature and by a significant degree of room-temperature tensile ductility, in the fully recrystallized as well as stress-relieved condition. Data are tabulated. (P.C.H.)

9498 (NYO-3228-6) SOLID-LIQUID INTERFACE. Progress Report. Li, Che-Yu (Cornell Univ., Ithaca, N. Y. Dept. of Materials Science and Engineering). Nov. 15, 1965. Contract AT(30-1)-3228. 8p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

Studies were made on the properties of interfaces emphasizing the correlation between structure and properties. The understanding of the structure of the interface between silver chloride and aqueous solutions has been increased. The Nb-Li system was chosen for studies on interaction between a solid metal and a liquid metal at the grain boundary. The results showed that the kinetics of initial stage of the penetration process follows a $(time)^{\frac{1}{2}}$ law with an activation energy of 33 ± 5 kcal in a temperature range between 800 and 1000°C. It was also found that the penetration rate depends strongly on the rate oxygen segregates toward the grain boundary. (P.C.H.)

9499 (RFP-544) METALLOGRAPHY OF WROUGHT VACUUM-CAST BERYLLIUM AT ELEVATED TEMPERATURES. Friebel, V. R. (Rocky Flats Div., Dow Chemical Co., Denver, Colo.). Nov. 22, 1965. Contract AT(29-1)-1106. 9p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

Microstructural changes in wrought vacuum-cast beryllium at elevated temperatures were studied with a vacuum hot-stage metallograph. The phenomena of grain growth and the removal of mechanical twins from the microstructure were recorded with a 16 mm movie camera. (auth)

9500 (UCRL-13190) FRICTION IN ULTRAHIGH VACUUM. Report No. MD-65-8. Frisch, J.; Nelson, R. D.; Pfaelzer, P. (California Univ., Berkeley. Inst. of Engineering Research). Sept. 1965. Contract W-7405-eng-48. 69p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

The design and construction of equipment for the investigation of friction behavior of single crystal surfaces in vacuum at 10^{-9} torr is described. A special hydraulic system provides the motion for the specimens, which are cleaned by sputtering in the vacuum chamber. Techniques for growing Al single crystals are given. An appendix contains a brief review on the theories of dry friction. (W.L.G.)

9501 (UCRL-14437) MELTING, FABRICATION, AND CREEP TESTING OF A 1.39 percent Ti + 0.34 percent Zr + 0.30 percent C MOLYBDENUM ALLOY. Conrad, H. F.; Landon, P. R. (Lawrence Radiation Lab., Univ. of California, Livermore). Nov. 1, 1965. Contract W-7405-eng-48. 22p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

The creep rupture strength values at 2400°F of TZC (0.3% C) were found to be about the same as those reported for commercial 0.15% carbon TZC alloy, rather than the much higher values previously reported for this high-carbon TZC composition. Creep properties at 2400 and 2600°F were disappointing. Because of the limited number of specimens available, it was not possible to investigate the improvement in properties no doubt possible through precipitation hardening heat treatments. In light of the recent work leading to a better understanding of the phase equilibria involved in this type of alloy, optimization of fabrication temperatures and procedures would additionally improve properties. Depletion of carbon at the specimen surface was found to occur during testing in conventional diffusion pumped vacuum systems. Decarburization apparently occurs as a result of a reaction between residual oxygen in the vacuum system and carbon in the specimen forming CO. Testing in an ultra-high vacuum, utilizing a sputter-ion pump, prevents decarburization. (auth)

9502 (UCRL-16379) THE EFFECT OF IMPURITY AND FOREST DISLOCATIONS ON THE FLOW STRESS OF COPPER. Gallagher, P. C. J. (Lawrence Radiation Lab., Univ. of California, Berkeley). Aug. 1965. Contract W-7405-eng-48. 36p. (CONF-650956-2). Dep. mn; CFSTI $2.00 cy, $0.50 mn.

From Conference on Lattice Defects, Honolulu, Hawaii.

Studies were made on the relative magnitudes of τ_s, short range, thermally activable part of the flow stress, and of τ_g, long range stress, for copper single crystals at room temperature. Known impurity contents and dislocation distributions were introduced to the crystals. By identifying the values of τ_s/τ_g characteristic of impurity-dislocation, and of forest-primary dislocation interactions it was possible to establish the regions of the stress-strain in which these reactions play an important role. Evidence exists for the effect of impurity on both τ_s and the total flow stress at low stresses. A strain rate change by a factor of 10 led to a stress in-

crement $\Delta\tau_s$, which is proportional to τ_s. The results also afforded detailed data on the variation of $V\tau$ with stress (V is the apparent activation volume), and the applicability of the Cottrell–Stokes Law. (P.C.H.)

9503 (WAPD-T-1683) THE EFFECTS OF OXYGEN ON SOME PROPERTIES OF HAFNIUM [Thesis]. Goodwin, James, G. (Pittsburgh Univ., Pa.). 1965. Contract AT-11-1-GEN-14. 53p. Dep. mn. CFSTI $3.00 cy, $0.50 mn.

The effects of oxygen on the hot and cold fabricability, hardness, recrystallization, tensile properties, weldability, impact strength, and corrosion resistance of hafnium were investigated. Oxygen contents over a range of about 50 to 1500 ppM were used. It was determined that homogeneous alloys of hafnium and oxygen can be melted and that these alloys can be successfully hot- and cold-fabricated into strip. The hardness of the HF–O alloys behaved as anticipated, increasing with increasing oxygen. Hot hardness measurements showed the strengthening effect of oxygen to exist at 1470°F. In the range of oxygen content studied, oxygen did not affect the recrystallization temperature. However, oxygen caused a substantial increase in the yield and ultimate strength of Hf up to 600°F. Corrosion tests in water at 680°F and steam at 750 and 850°F revealed no effects of oxygen on the corrosion rate of Hf. It was concluded that the oxygen content of Hf for production should be specified as the range of 100 to 400 ppM. (P.C.H.)

9504 (WAPD-TM-472) THERMAL EXPANSION AND PREFERRED ORIENTATION IN ZIRCALOY. Kearns, J. J. (Bettis Atomic Power Lab., Pittsburgh, Pa.). Nov. 1965. Contract AT(11-1)-Gen-14. 39p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

An x-ray method based on analysis of intensities in a diffractometer scan was developed to characterize preferred orientation in materials of hexagonal crystal structure. The method was applied to Zircaloy-4 swaged rod and to plate fabricated by four different processes. The data were used to determine an orientation parameter that can be used to calculate physical properties from single crystal values, or single crystal values from property measurements on polycrystalline samples. Measurements of thermal expansivity were used to verify the x-ray method, and single crystal values deduced from these data agreed well with published results. The x-ray data also were used to examine the applicability of the texture coefficient method to normalize intensity data from Zircaloy specimens. (auth)

9505 (WAPD-TM-521) X-RAY LINE BROADENING: ITS SOLUTION AND APPLICATION THROUGH THE USE OF A DIGITAL COMPUTER. Berman, R. M.; Katz, O. M. (Bettis Atomic Power Lab., Pittsburgh, Pa.). Nov. 1965. Contract AT(11-1)-Gen-14. 19p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Computer program MO615 was written to utilize the Fourier transform method to correct broadened x-ray lines for experimental conditions without any assumptions as to peak shape. By comparison to the appropriate standard line no other corrections are needed to directly apply the true diffraction broadening given by the computer. A number of plots are also produced which allow a critical analysis of whether small crystallite size or strain broadening is more prominent. Such an analysis can be done with just one diffracted line. Examples of small crystallite size broadening for a UO_2 product and strain broadening for cold-rolled zirconium foil are included. (auth)

9506 (ORNL-tr-922) INFLUENCE OF TRACES OF LEAD AND RARE EARTHS ON THE STRUCTURE AND MECHANICAL CHARACTERISTICS OF STAINLESS STEEL. Ravizza, P.; Nicodemi, W. Translated for Oak Ridge National Lab., Tenn., from Rev. Met. (Paris), 62: 351-7(1965). 16p. Dep. mn; JCL $1.60 fs, $0.80 mf.

By means of a hot crushing test, the hot working properties of a high purity steel were determined as a function of traces of lead and rare earths. The influence of this group of elements on certain meachanical characteristics of this type of steel was also investigated. It was found that increasing contents of lead can be correlated with a difference in hardness between the center and the boundary of the austenitic grain. The influence of an addition of rare earths on this hardness difference was also observed. Variation in shape and surface of the austenitic grain due to the presence of lead and rare earths was examined after hot working. Some hypotheses are proposed which explain the technological behavior of the steel on the basis of micrographic studies. (auth)

9507 SPECIAL FEATURES OF THE USE OF URANIUM DIOXIDE AS THE FUEL IN POWER-REACTORS. Chenebault, P.; Francois, B. (CEN, Grenoble, France). Bull. Soc. Franc. Ceram., No. 66, 81-102(Jan.-Mar. 1965). (In French).

The use of uranium dioxide in reactors is discussed. Research shows that, because of the low thermal conductivity of UO_2, a fuel element made of this oxide will operate at a very high core temperature with a steep temperature gradient to the outside. The problem of determining the temperature distribution through the fuel in relation to its process of manufacture is considered. The appearance of rare gases, such as xenon and krypton, produced by the fission of the uranium, poses the problem of the distribution of these gases in the UO_2 and particularly their migration through the fuel; these gases can set up significant pressures in the fuel element and can also form an additional heat barrier between the UO_2 and the can. It is therefore necessary to determine the laws controlling their displacement by effusion from the pile and within the pile. The experimental methods used are described. The results obtained showed that the migration of gases out of the fuel element can impose, in some types of reactor, a severe technological limitation. The mechanisms at present proposed to take account of this escape of fission gases are discussed. (auth)

9508 GRAPHITE. Young, D. A. Discovery, 26: 44-8(Dec. 1965).

The materials science aspects of research on pyrolytic graphite are reviewed. The physical properties of pyrolytic graphite are described. Ideal and real crystals, preparation of pyrolytic graphite, phonons and charge carriers, thermal properties, electric resistance, and graphite in materials research are discussed. The preparation of synthetic pyrolytic graphite using a susceptor/die arrangement is shown. The graphite column is hot pressed at about 2900°C to produce a specimen whose density is very close to theoretical. Electrons carrying electric charge through the crystal are treated theoretically in terms of the Fermi surface. A diagram of the Fermi surface is shown. The thermal resistance curves for graphite are also shown. The electrical resistance of graphite showed anisotropies of 4000 at 300°K, 12,200 at 77°K, and 88,600 at 4.2°K. (F.J.H.)

9509 EXPERIMENTAL DETERMINATION OF THE LORENZ NUMBER OF LIQUID SODIUM. Evangelisti, R.; Isacchini, F. (CNEN, Rome). Energia Nucl. (Milan), 12: 601-4(Nov. 1965).

The thermal conductivity and electric resistivity of liquid sodium were measured in the temperature range 100 to 900°C: both measurement devices were filled by liquid metal distillation. An axial heat-flow apparatus utilizing compensating guard heating was used for the thermal conductivity measurement, of which the accuracy was evaluated as ±5% in the whole range. A method based on measuring the resistance of the sodium in parallel with a type 316 stainless steel metal container was employed for the electric resistivity measurement. The Lorentz number was calculated from the results as a function of temperature, and the results are shown in comparison with other experimental and theoretical results. (L.B.S.)

9510 INVESTIGATION OF THE TEMPERATURE DEPENDENCE OF LANTHANUM AND NEODYMIUM HARDNESS AT 77 TO 293 deg K. Bol'shutkii, D. N.; Krot, Yu. E.; Moskalenko, V. A. (Physical-Technical

Inst. of Low Temperatures, Academy of Sciences, Ukrainian SSR). Fiz. Metal. Metalloved., 20: 465-7(Sept. 1965). (In Russian).

In order to determine the low-temperature hardness of La and Nd the pure (99.3 and 99.2% pure, respectively) metals were melted in an induction furnace under vacuum, preparing 20-mm diameter and 3-mm thick disc-shaped specimens which were polished and annealed in vacuum for 1 hour at 600°C. Metallographic examination revealed that the average grain size of the La and Nd specimens was 0.12 and 0.07 mm, respectively. A portion of the specimens were mechanically deformed. A Vickers instrument provided with liquid nitrogen cooling was used for measuring hardness. It was found that deformation to the extent of 40% at room temperature increases the hardness of both metals by 60% with respect to annealed specimens; this finding does not agree with previously reported observations. A similar temperature dependence was exhibited by both metals. The results follow a relationship of $H = A_e^{-\alpha T}$, where A is a characteristic of the interatomic forces acting in the crystal lattice and α is the temperature coefficient of hardness. The expected polymorphic transformation of La was not observed. (TTT)

9511 MAGNETIC PROPERTIES OF INTERMETALLIC COMPOUNDS BETWEEN THE LANTHANIDES AND NICKEL OR COBALT. Farrell, John; Wallace, W. E. (Univ. of Pittsburgh). Inorg. Chem., 5: 105-9(Jan. 1966).

The magnetic properties of two groups of intermetallic compounds are reported: the $LnNi_2$ and the $LnCo_2$ series, where Ln represents Ce, Pr, Nd, Sm, Gd, Tb, Dy, Ho, Er, Tm, and Y. These compounds are all isostructural, having the $MgCu_2$ structure. $CeNi_2$ and YNi_2 exhibit only Pauli paramagnetism. $CeCo_2$ may have a Curie temperature below 2°K. All other compounds order magnetically with Curie temperatures ranging from 12°K for $TmNi_2$ to 410°K for $GdCo_2$. Except for nonmagnetic $CeNi_2$ and YNi_2 for $SmNi_2$, where the multiplet spacing is comparable with kT, all compounds in the $LnNi_2$ series exhibited Curie–Weiss behavior in the paramagnetic region, with effective moments as expected of the free tripositive lanthanide ions. In the $LnCo_2$ series, however, the behavior in the paramagnetic region is more complex. Improved values for the moments of the compounds in the ferromagnetic state are presented and compared with available neutron diffraction results. Crystal field effects partially quench the orbital angular momentum of the lanthanide ions. However the quenching is weaker in $LnNi_2$ than was expected on the basis of considerations set forth by Bleaney so that the effects are only apparent in the ferromagnetic region and at 4°K. The quenching effects are stronger in the $LnNi_2$ than in the $LnCo_2$ series. (auth)

9512 EFFECTS OF ALUMINUM ON THE STABILITY OF THE β PHASE OF Ti–Mn–Mo ALLOYS. Ageev, N. V.; Novik, P. K. Izv. Akad. Nauk SSSR, Metal., No. 5, 134-8 (Sept.-Oct. 1965). (In Russian).

In alloys of the system Ti–Mn–Mo an increase of Al from 1 to 30% markedly increased the stability of the β phase during aging. The introduction of Al at concentrations of 1% decreased the formation of the metastable ω phase during decomposition of β phase alloys containing 16% Mo + Mn. In alloys containing 12 to 13% Mo + Mn, the addition of 1 and 2% Al abruptly decreased the existence time of the ω phase at 673°K. At 3% Al the formation of the ω phase at 673°K was completely inhibited. The effect of Al on the decomposition kinetics of the high-temperature β phase was investigated at temperatures from 573 to 773°K. It was established that Al inhibits the diffusion process leading to decomposition of the β phase, increases the duration of the induction period, and inhibits the growth and coagulation of crystals of the α phase leading to decomposition. Compositions of Ti with approximately 18% Mo + Mn and 3% Al were recommended for development for industrial thermostable alloys with mechanical stability of the phase. (tr-auth)

9513 PREPARATION AND CONSTITUTION DIAGRAM OF Nd–Te ALLOYS. Abrikosov, N. Kh.; Zargaryan, V. Sh. (Baikov Inst. of Metallurgy, USSR). Izv. Akad. Nauk SSSR, Neorg. Mater., 1: 1462-7(Sept. 1965). (In Russian).

A method for the synthesis of Nd tellurides was developed. The method made it possible to obtain homogeneous powders corresponding in composition to NdTe, Nd_3Te_4, Nd_2Te_3, Nd_4Te_7, $NdTe_2$, Nd_2Te_5, and $NdTe_3$. These compositions were obtained after remelting and formation of fixed samples of stoichiometric composition. A thermal analysis method was developed for Nd and Te systems using a W–Re thermocouple and fusion of the samples in Ta crucibles. The heating was accomplished by high frequency generators. By thermal and microstructure analysis, the constitution diagram of the Nd–Te system was determined. The compound richest in Nd(NdTe) melted with a clear maximum at 1755 ± 15°C. These compounds formed a eutectic with Nd at 5 at. % Te, melting at 970°C. The compounds corresponding to the compositions Nd_3Te_4, Nd_2Te_3, Nd_4Te_7, $NdTe_2$, Nd_2Te_5, and $NdTe_3$ were formed by peritectic reactions at temperatures of 1465, 1315, 1255, 1120, 925, and 885°C. $NdTe_3$ formed a degenerate eutectic with Te. The data on the temperature of the eutectic formation reactions of Nd_2Te_5 and $NdTe_3$ were in satisfactory agreement with earlier studies. (tr-auth)

9514 GADOLINIUM–GERMANIUM COMPOUNDS AND THEIR CRYSTALLINE STRUCTURE. Gladyshevskii, E. I.; Burnashova, V. V. Izv. Akad. Nauk SSSR, Neorg. Mater., 1: 1508-12(Sept. 1965). (In Russian).

By x-ray and microstructure analysis of 16 alloys of the binary system Gd–Ge, the existence of the compounds GdGe, Gd_2Ge_3, $GdGe_2$, and $GdGe_3$ was confirmed and the compounds Gd_5Ge_3 and $GdGe_{2-n}$ were found. The compounds belong to the following structural types: Gd_5Ge_3 is of the Mn_5Si_3 type with the space group $P6_3/\underline{mcm} - D_{6h}^3$, a = 8.58 ± 0.01 and c = 6.45 ± 0.01 Å; GdGe is of the type CrB, $\underline{Cmcm} - D_{2h}^{17}$; a = 4.33 ± 0.01, b = 10.79 ± $^{+}$0.02, and c = 3.98 + 0.01 Å; Gd_2Ge_3 has a defective structure of the AlB_2 type, $P6/\underline{mmm} - D_{6h}^1$, a = 3.973 ± 0.003 and c = 4.179 ± 0.003 Å; $GdGe_{2-n}$ is of the type a-$GdSi_2$, $\underline{Imma} - D_{2h}^{28}$, a = 4.130 ± 0.003, b = 4.096 ± 0.003, and c = 13.76 ± 0.01 Å; $GdGe_3$ is of the type a-$ThSi_2$, $14/\underline{amd} - D_{4h}^{14}$ a = 4.12, c = 13.72 Å (literature data); the structure of $GdGe_3$ was not determined. (tr-auth)

9515 RARE EARTH COMPOUNDS WITH ZINC AND THEIR CRYSTAL STRUCTURE. Kuz'ma, Yu. B.; Kripyakevich, P. I.; Frankevich, D. F. (Lvov State Univ.). Izv. Akad. Nauk SSSR, Neorg. Mater., 1: 1547-53(Sept. 1965). (In Russian).

The existence of the compounds R_6Zn_{23} (type Th_6Mn_{23} where R = Tb, Ho, Er, and Y), $EuZn_5$ (type CaCu), R_2Zn_{17} (type Th_2Ni_{17} where R = Sm, Gd, Dy, Ho, Tm, and Y), RZn_{12} (type $ThMn_{12}$ where R = Tb, Dy, Er, and Y), and RZn_{11} (type $BaCd_{11}$ where R = Nd, Eu, and Yb) was established; the lattice parameters are reported. (tr-auth)

9516 STUDIES OF ZIRCONIUM–COBALT ALLOYS. Kuprina, V. V.; Bataleva, S. K.; Sokolova, I. G. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Neorg. Mater., 1: 1554-7(Sept. 1965). (In Russian).

By microscopic and x-ray methods, the phase diagram of the system Zr–Co was studied at temperatures from room temperature up to 950°C. For the first time the existence of 3 chemical compounds ZrCo, Zr_2Co, and Zr_3Co was established. They crystallized from the liquid state and formed a wide range of mechanical mixtures of the eutectic and peritectic types. The existence of the compound $ZrCo_2$ was confirmed. The compound CoZr has a cubic lattice of the CsCl type with the lattice parameter a = 3.163 ± 0.003 Å. The compound $CoZr_2$ has a tetragonal lattice of the $CuAl_2$ type with the lattice parameters a = 6.425 ± 0.003 and c = 5.726 ± 0.003 Å and c/a = 0.860. The compound $CoZr_3$ has the hexagonal lattice of the type $MdCd_3$ with the parameters a = 5.966 ± 0.003 and c = 4.660 ± 0.003 Å and c/a = 0.781. (tr-auth)

9517 CRYSTALLINE STRUCTURE OF RHENIUM AND PRASEODYMIUM COMPOUNDS. Savitskii, E. M.;

Khamidov, O. Kh. (Baikov Inst. of Metallurgy, USSR). Izv. Akad. Nauk SSSR, Neorg. Mater., 1: 1621-2(Sept. 1965). (In Russian).

In the Pr–Re system, the formation of polymorphic compounds of $PrRe_2$ was established. The high-temperature modification of $PrRe_2$ crystallized in a cubic crystal lattice of the Laves phase of the $MgCu_2$ type and the low-temperature modification crystallized in the hexagonal lattice of the Laves phase of the $MgZn_2$ type. The compound $PrRe_2$ was stable up to 1200°C and did not have a wide range of homogeneity. (tr-auth)

9518 SOME OBSERVATIONS ON THE GRAIN REFINEMENT OF URANIUM. Taplin, D. M. R. (Univ. of Melbourne); Martin, J. W. J. Brit. Nucl. Energy Soc., 4: 359-62(Oct. 1965).

The results of an investigation of the control of uranium grain size by various heat treatments and the addition of trace amounts of Al and Fe are presented. The results indicate that the important criterion in grain refinement of Calder fuel rods by adjustment is the increasing amount of dispersion network which retards alpha grain growth. (D.C.W.)

9519 SMALL-DEFLECTION CREEP BUCKLING OF MAGNESIUM ALLOY (MAGNOX AL80) AT 295 deg C. Freed, N. H.; Seyna, F. J. Mech. Eng. Sci., 7: 328-34 (Sept. 1965).

The results of creep buckling experiments at 295°C on magnesium alloy specimens of two different diameters were compared with deflection rates predicted from a simple theory proposed by Alexander. Agreement was found to be adequate for design purposes, and within the scatter of the material data. The effect of eccentricity was evaluated and shown to have a negligible effect on bowing rates. (auth)

9520 THE EFFECT OF HIGH PRESSURE ON THE COMPRESSIBILITY OF FOUR CUBIC CARBIDES. Champion, A. R.; Drickamer, H. G. (Univ. of Illinois, Urbana). J. Phys. Chem. Solids, 26: 1973-5(Dec. 1965). (COO-1198-268).

The effect of pressure to several hundred kbars was measured on the compressibility of four carbides having the NaCl structure. All four are relatively incompressible but the group IV carbides (TiC and ZrC) are markedly more compressible than the group V carbides (NbC and TaC). The compressibility increases as one goes down the periodic table. (auth)

9521 CONTRIBUTION TO THE STUDY OF THE MECHANISM OF $\delta \rightarrow \gamma$ TRANSFORMATION IN PLUTONIUM. Hocheid, B.; Tanon, A.; Miard, F. (CEA, Paris). Mem. Sci. Rev. Met., 62: 683-90(Sept. 1965). (In French).

A dilatometric study of the $\delta \rightarrow \gamma$ transformation during cooling at a moderate rate showed two stages. The first stage corresponded to the formation by nucleation and growth of a γ phase enriched with certain impurities, particularly uranium. The second phase transformation was of the martensitic type. (auth)

9522 INFLUENCE OF PRESSURE ON STABILIZATION OF δ-PHASE PLUTONIUM BY GALLIUM. Roux, C.; le Roux, P.; Rapin, M. (CEA, Paris). Mem. Sci. Rev. Met., 62: 691-2(Sept. 1965). (In French).

The behavior of plutonium alloy specimens subjected to hydrostatic pressure was studied. Measurements were made of the relative change in apparent resistance and of apparent volume change as a function of the pressure. The minimum theoretical concentration of gallium able to stabilize δ phase plutonium at room temperature was 0.9 at. %. (auth)

9523 FERMI SURFACE, MAGNETIC ORDERING, AND ELECTRICAL PROPERTIES OF RARE-EARTH METALS. Freeman, A. J. (Massachusetts Inst. of Tech., Cambridge); Dimmock, J. O.; Watson, R. E. Phys. Rev. Lett., 16: 94-7(Jan. 17, 1966).

The complete Fermi surface for Tm metal was determined from nonrelativistic augmented plane-wave energy-band calculations. It was found that the striking anomalies which occur in the c-axis resistivity of the heavy rare-earth metals at the onset of long-range periodic magnetic order can be understood in terms of the calculated energy bands and Fermi surface. (D.C.W.)

9524 RECRYSTALLIZATION DIAGRAMS FOR SINTERED MOLYBDENUM AND TUNGSTEN. Pink, E. (Metallwerk Plansee AG., Reutte/Tirol, Austria). Planseeber. Pulvermet., 13: 100-4(Aug. 1965). (In German).

Recrystallization diagrams for sintered and wrought molybdenum and tungsten were derived and the effect of initial grain size analyzed. (auth)

9525 A DIFFERENTIAL THERMAL ANALYSIS APPARATUS FOR HIGH TEMPERATURES. HIGH TEMPERATURE PHASE REACTIONS IN REFRACTORY CARBIDE SYSTEMS. Heetderks, H. D.; Rudy, E.; Eckert, T. (Aerojet-General Corp., Sacramento, Calif.). Planseeber. Pulvermet., 13: 105-25(Aug. 1965).

A high-sensitivity differential thermal analysis apparatus, capable of operating to temperatures of 3600°C under controlled time-temperature conditions, is described. Measurements on binary and ternary carbide systems revealed a number of previously undetected phase reactions. With the exception of V_2C, all subcarbides of the refractory transition metals undergo isothermal phase changes at high temperatures. The lower temperature stability limits of the high-temperature phases in the systems Mo-C and W-C were determined. Similar to the corresponding system with oxygen, the α modification of hafnium was stabilized to higher temperatures by carbon additions, while the α-β transformation in titanium and zirconium was affected only to a moderate extent. The application of DTA techniques to the investigation of nonvariant equilibria involving a liquid phase and to the study of reaction kinetics (disproportionation of solid solutions, reactions along non-equilibrium paths, reactions involving order-disorder phenomena) is discussed and examples are given. (auth)

9526 A POSSIBLE NUCLEAR CONTRIBUTION TO THERMAL EXPANSION. Hirschkoff, E. C.; Wolcott, N. M. (National Bureau of Standards, Washington, D. C.). Proc. Phys. Soc. (London), 86: 1372-4(Dec. 1965).

A significant contribution to the thermal expansion of a ferromagnetic material at low temperatures due to nuclear interaction with the static hyperfine field is predicted. Some numerical examples are given for cobalt and rare-earth metals. (auth)

9527 SPIN DEPENDENCE OF THE ELECTRICAL RESISTIVITIES OF GADOLINIUM ALLOYS. Chen, C. W. (Westinghouse Electric Corp., Pittsburgh). Solid State Commun., 3: 231-3(Sept. 1965).

The electric resistivities of various intra-rare-earth alloys of gadolinium at 4.2, 77, and 298°K are discussed with respect to the current theory. Two spin effects are shown in the scattering of the conduction electrons. (auth)

9528 MAGNETOSTRICTION IN A TERBIUM SINGLE CRYSTAL. du Plessis, P. de V.; Alberts, L. (Univ. of Orange Free State, Bloemfontein, South Africa). Solid State Commun., 3: 251-2(Sept. 1965).

The magnetostriction of a single crystal of terbium was studied over a wide range of temperature using a strain-gauge technique. The results were compared with x-ray measurements. (D.C.W.)

9529 ELECTRON-SPINWAVE SCATTERING IN GADOLINIUM. Luethi, B.; Rohrer, H. (International Business Machines Corp., Zurich). Solid State Commun., 3: 257-61(Sept. 1965).

The electric resistivity due to magnetic scattering in polycrystalline gadolinium has been determined in the temperature range between 4.2 and 30°K. The part of the resistivity due to scattering by domains and magnetic impurities is practically independent of temperature, whereas that due to spin-wave scattering follows above

10°K a $T^{3.1\pm0.2}$ law and is considerably smaller than the resistivity due to phonon scattering. The temperature dependence of the latter varies between $T^{3.5}$ and $T^{3.8}$. (auth)

9530 ELECTRICAL RESISTIVITY AND MAGNETORESISTANCE OF DILUTE Mg–Nd, Mg–Gd, Ag–Nd, Ag–Gd AND Ag–Ho ALLOYS. Bijvoet, J.; de Hon, B.; Dekker, J. A.; van Beek, Flora (Univ., Amsterdam). Solid State Commun., 3: 289-91(Sept. 1965).

The electric resistivity and magnetoresistance of Gd–Mg, Gd–Ag, Ho–Ag, Mg–Nd, and Nd–Ag alloys were investigated at liquid helium temperatures. The effects of concentration, temperature, and magnetic field strength were studied. (D.C.W.)

9531 SOLID SOLUBILITY OF MAGNESIUM IN SOME LANTHANIDE METALS. Joseph, R. R.; Gschneidner, K. A. Jr. (Ames Lab., Ames, Iowa). Trans. Met. Soc. AIME, 233: 2063-9(Dec. 1965). (IS-1174).

The solid solubility of magnesium in the close-packed modifications of lanthanum, cerium, praseodymium, neodymium, gadolinium, dysprosium, and lutetium was determined from approximately 250°C to the eutectoid temperature by x-ray parametric techniques. The maximum solubility at the eutectoid temperature was found to be 9.4 at. % in La, 8.2 in Ce, 9.2 in Pr, 8.2 in Nd, 14.1 in Gd, 13.5 in Dy, and 11.5 in Lu. The solubility when compared at a homologous temperature was found to increase in a smooth manner with decreasing size factor from lanthanum to lutetium. It was found that the apparent atomic radius of magnesium when dissolved in the lanthanide solvent was constant and could be accounted for by consideration of several models dealing with departures from Vegard's law. The eutectoid temperatures for the lanthanide-rich La–Mg, Ce–Mg, and Nd–Mg systems were found to be 544, 505, and 551°C, respectively. (auth)

9532 ON THE OCCURRENCE OF SOME U_2X COMPOUNDS OF URANIUM WITH TRANSITION METALS. Berndt, A. F.; Dwight, A. E. (Argonne National Lab., Ill.). Trans. Met. Soc. AIME, 233: 2075-8(Dec. 1965).

Binary and ternary alloys of uranium with transition metals were prepared with U_2X stoichiometry. The compounds U_2Tc, U_2Rh, U_2Os, and U_2Ir were formed by peritectic or peritectoid transformations, and shown to be isostructural with U_2Ru. The lattice constants are presented. Miscibility relations obtained from the study of ternary alloys are graphically summarized in terms of an area-of-stability plot. The compound U_2Re is not isostructural with either U_2Ru or U_2Mo. (auth)

9533 CONSTRUCTION OF A CONSTITUTION DIAGRAM PROJECTED WITH NUMERICAL VALUES. Pervikova, V. N.; Pryakhina, L. I.; Podylina, M. G. Zh. Neorg. Khim., 10: 2198-9(Sept. 1965). (In Russian).

The validity of the projection of constitution diagrams with numerical values was evaluated on two systems of γ_4-Ni_3Al–Ni_3Ti–Ni_3Nb (γ_4 = 81 wt % Ni, 10 wt % Cr, 6 wt % W, and 3 wt % Mo). The results showed that the representation of the diagram by the method of projection with numerical values causes no difficulty in the determination of the composition at any point of the diagram. (J.S.R.)

9534 DESCRIPTION OF THE BELGONUCLEAIRE-C.E.N. WORK ON PLUTONIUM BEARING CARBIDES. Bairiot, H. (Belgonucleaire, Brussels); Lafontaine, I.; Pizziolo, A. pp 469-84 of Carbides in Nuclear Energy. Vol. 2. Russell, L. E. (ed.). London, Macmillan and Co., Ltd., 1964.

The work was primarily concerned with the development of plutonium enriched carbide fuel elements. The main effort was devoted to ceramic fuel fabrication. The method which was used for production of the plutonium bearing carbides was direct carburization of the oxide. Experiments carried out in argon and vacuum resulted in the production of single phase PuC. The mixed carbides (UPu)C were also prepared in the range 10–30 mol% plutonium carbide. Two general approaches to fuel element fabrication were looked at, the first being arc melting and casting and the second vibratory compaction followed by swaging. (auth)

9535 THE SINTERING OF (UPu)–C IN ARGON. Harrison, J. D. L.; Isaacs, J. W.; Roberts, W. G.; Russell, L. E. (Atomic Energy Research Establishment, Harwell, Eng.). pp 629-47 of Carbides in Nuclear Energy. Vol. 2. Russell, L. E. (ed.). London, Macmillan and Co., Ltd., 1964.

$(U_{0.85}\ Pu_{0.15})C$ prepared by arc-melting the mixed elements, or by reducing the oxides with C in flowing Ar, or in vacuum, was sintered to >95% theoretical density in Ar at 1500–1600°C. To achieve these results it is necessary to reduce the mean particle diameter to ~2 μ and to protect the powders from oxidation before or during sintering. (auth)

9536 THE POWDER METALLURGY AGGLOMERATION PROCESS FOR FABRICATION OF CARBIDE SPHERICAL PARTICLES. Gorle, F. (Laboratoires du Centre d'Etude de l'Energie, Nucleaire, Mol-Donk, Belg.); Huet, J. J. pp 763-76 of Carbides in Nuclear Energy. Vol. 2. Russell, L. E. (ed.). London, Macmillan and Co., Ltd., 1964.

The advantages and disadvantages of the rotary sieving method are discussed in relation to the specific characteristics of carbide fuels which involve the problems associated with handling uranium and thorium carbides, which, in fine powder form, are extremely reactive to the atmosphere. Attention is directed to the choice of starting materials and consideration given to the mechanisms of the various processes involved. The physico-chemical principles associated with the action of the binder on particle formation are considered and experiments to illustrate these principles described. The introduction of excess carbon into the particle emphasised the importance of the structure of the various sources of carbon. An electron microscopic study showed the influence of the shape and dimensions of carbon powders on spheroidization, and the results are discussed in relation to the interaction of the different types of carbon with different binders. (auth)

9537 SYMPOSIUM ON NEWER STRUCTURAL MATERIALS FOR AEROSPACE VEHICLES. Sixty-seventh Annual Meeting, American Society for Testing and Materials, Chicago, Ill, June 21, 1964. ASTM Special Technical Publication No. 379. Philadelphia, American Society for Testing and Materials, 1965. 125p. $6.00. (CONF-512).

Separate abstracts were prepared for four of the eight papers. Subjects of papers not abstracted include: fused silica as an aerospace material; testing 1-mil molybdenum-faced foil sandwich up to 1800°F; materials needs for energy absorption in space-vehicle landings; and, thermal-structural composites for aerospace applications. (W.L.G.)

For abstracts of individual papers see: 9391, and 9538–9540.

9538 NEW DUCTILE BERYLLIUM–ALUMINUM WROUGHT ALLOYS. Fenn, R. W. Jr., Crooks, D. D.; Pasternak, R. C. (Lockheed Missiles and Space Co., Palo Alto, Calif.). pp 3-14 of Symposium on Newer Structural Materials for Aerospace Vehicles. ASTM Special Technical Publication No. 379. Philadelphia, American Society for Testing and Materials, 1965.

The properties of a new series of ductile Be–Al alloys, which were specifically designed for use in aerospace vehicles, are described. Young's modulus, bend, and tensile properties of sheet and extrusion alloys containing between 24 and 43 % Al are presented. The elevated-temperature tensile properties to 1000 F are given for both rolled and extruded material containing 36% Al. The effect of temperature on Young's modulus of an extruded Be–31.4% Al alloy is also given to 1000 F. Structural efficiency comparisons are made between Be and competitive materials, in some cases, to 1000 F. The improved ductility, machinability, weldability, and formability of these new alloys, as well as the lack of brittleness and freedom from chemical etching requirements, as compared to currently available commercial purity Be, should result

in significantly lower installed cost than for Be. Substitution of Be–Al alloys for currently used HM21A-T8 and HK31A-H24 Mg alloys could result in weight savings on the order of 40%. (auth)

9539 NONMETALLIC MATERIALS FOR HIGH-TEMPERATURE STRUCTURAL APPLICATIONS. Kendall, E. G.; McClelland, J. D. (Aerospace Corp., El Segundo, Calif.). pp 71-90 of Symposium on Newer Structural Materials for Aerospace Vehicles. ASTM Special Technical Publication No. 379. Philadelphia, American Society for Testing and Materials, 1965.

The urgent need for high-temperature aerospace materials is spurring the development of the refractory nonmetallic materials, including the carbides, graphites, oxides, borides, and beryllides. The materials are discussed with emphasis on high-temperature structural applications. A detailed compilation of property data is presented, aerospace applications described, limitations of the materials reviewed, and promising areas of research outlined. These include the prestressing of oxides for rocket nozzle inserts and the carbide-graphite eutectics for improved thermal shock resistance. (auth)

9540 EXTRUSION OF BERYLLIUM STRUCTURAL SHAPES. Siergiej, J. M. (Nuclear Metals, Concord, Mass.). pp 106-18 of Symposium on Newer Structural Materials for Aerospace Vehicles. ASTM Special Technical Publication No. 379. Philadelphia, American Society for Testing and Materials, 1965.

Special techniques employed during the extrusion of beryllium are reviewed, and it is shown that extrusions of complex shapes can be produced in long lengths. A limitation of the process is that the cross section of the shape must have width and wall thickness dimensions to enable it to be circumscribed by a circle having an area approximately 12 to 40 times the cross-sectional area of the shape desired; also, that a die design can be developed to ensure cladding flow without break-through. (W.L.G.)

9541 THE PREPARATION AND SOME PROPERTIES OF URANIUM SESQUICARBIDE. Norreys, J. J.; Wheeler, M. J.; Gillam, E. (General Electric Co. Ltd., Wembley, Eng.). pp 1-6 of Carbides in Nuclear Energy. Vol. 1. Russell, L. E. (ed.). London, Macmillan and Co., Ltd., 1964.

Uranium sesquicarbide was prepared by surface grinding drop castings of the required composition and heating at 1300 to 1600°C. Attempts to prepare the compound without some form of room temperature working were unsuccessful. The progress of the UC + UC_2 → U_2C_3 transformation was followed by resistivity measurements. The resistivity of U_2C_3 was measured at temperatures up to the peritectoid temperature. Between 1000 and 1600°C the resistivity is independent of temperature. The thermal expansion was measured to 1000°C, a mean value from room temperature being 10.49×10^{-6}/°C. The microhardness of U_2C_3 is 1500 kg/mm², using a 50 g load, and the macrohardness 1080 VPN. (auth)

9542 STUDIES ON URANIUM DICARBIDE AND SESQUICARBIDE. Imoto, S. (Osaka Univ.); Sano, T.; Takada, Y.; Yamamoto, K.; Watanabe, K.; Isoda, T.; Uchikoshi, H. pp 7-21 of Carbides in Nuclear Energy. Vol. 1. Russell, L. E. (ed.). London, Macmillan and Co., Ltd., 1964.

Experiments were carried out to determine the composition of UC_2 by C analysis, x-ray diffractions methods and metallographic investigation of sintered uranium carbides of differing C contents near the UC_2 composition. The results suggest that cubic UC_2 is more accurately represented by the formula $UC_{1.86 \pm 0.02}$ (8.6 ± 0.1 wt% C). It was found that tetragonal UC_2 contained slightly more C than cubic UC_2, and corresponded to the formula $UC_{1.96 \pm 0.04}$. The U–C phase diagram near the UC_2 composition was revised on the basis of these results. The kinetics of the transformation of cubic UC_2 to tetragonal UC_2 suggest that this is a diffusionless martensitic transformation. Experiments were performed to study the critical temperature below which the decomposition of tetragonal UC_2 into U_2C_3 + C takes place. This temperature was found to be between 1500 and 1600°C. The reaction, UC + UC_2 → U_2C_3, takes place simultaneously in carbides of suitable composition, and was found to proceed more rapidly than the decomposition reaction below this temperature range. The factors affecting these two reactions were investigated. (auth)

9543 THE SOLUBILITY OF URANIUM IN URANIUM MONOCARBIDE. Magnier, P. (Centre d'Etudes Nucleaires, Saclay, Gif-sur-Yvette, France); Accary, A. pp 22-32 of Carbides in Nuclear Energy. Vol. 1. Russell, L. E. (ed.). London, Macmillan and Co., Ltd., 1964.

Uranium–carbon alloys can exist as a single phase hypostoichiometric UC for C contents between 48 and 50 at. %. The variation of the lattice parameter of these alloys as a function of composition was determined and used to evaluate, as a function of temperature, the composition of hypostoichiometric UC in thermodynamic equilibrium with metallic U or with UC_2. It was shown that maximum solubility of U takes place at 1700 ± 30°C, the composition of hypostoichiometric UC in equilibrium with metallic U being $UC_{0.96}$. The effect of these observations on the nature of the U–C phase diagram is discussed. (auth)

9544 ELECTRON MICROSCOPE STUDIES OF URANIUM DICARBIDE IN SINGLE CRYSTALS OF URANIUM CARBIDE. Eyre, B. L. (Atomic Energy Research Establishment, Harwell, Eng.); Sole, M. J. pp 33-40 of Carbides in Nuclear Energy. Vol. 1. Russell, L. E. (ed.). London, Macmillan and Co., Ltd., 1964.

A method for preparing thin films of UC single crystals containing UC_2 precipitates is described. The films were examined by transmission electron microscopy, and using selected area diffraction techniques the crystallographic relations between the UC_2 and the UC matrix were established. Twinning is observed in the UC_2 precipitates, and this is attributed to the interactions that occur when UC_2 crystals of different orientation intersect. (auth)

9545 ORIENTATION RELATIONSHIPS BETWEEN MONOCARBIDE AND DICARBIDE PHASES IN URANIUM–CARBON ALLOYS. Magnier, P. (Centre d'Etudes Nucleaires de Saclay, Gif-sur-Yvette, France); Collard, C.; Tournarie, M.; Accary, A. pp 41-50 of Carbides in Nuclear Energy. Vol. 1. Russell, L. E. (ed.). London, Macmillan and Co., Ltd., 1964.

A dicarbide layer was grown on the (100) cleaved faces of single crystals of UC by reaction with graphite. After cooling to room temperature, Laue x-ray photographs showed that: when growth took place at 1900°C, a (110) face of the dicarbide was parallel to the cleaved (100) monocarbide face and the orientation relation was: $\langle 100 \rangle_{UC_2} \parallel \langle 100 \rangle_{UC}$ $[001]_{UC_2} \parallel [001]_{UC}$ (I). When growth took place at 1750°C, an (001) plane of UC_2 was parallel to the (100) UC face, the orientation relation being: $\langle 001 \rangle_{UC_2} \parallel \langle 100 \rangle_{UC}$ $[110]_{UC_2} \parallel$ $[100]_{UC}$ (II). Relation I can be explained if it is assumed that at 1900°C, the UC_2 structure can be developed from that of UC by replacing the C atoms of the latter by C_2 pairs and that the cubic UC_2 thus obtained transforms into tetragonal UC_2 by a martensitic mechanism. Relation II is epitaxial. By comparing the x-ray patterns obtained with those obtained for a U–C alloy made by cooling a melt containing 37 wt% UC_2, it was shown that relation I holds for materials obtained by solidification of a melt. (auth)

9546 CELL SIZE VARIATIONS IN THORIUM MONOCARBIDE. Henney, J. (Atomic Energy Research Establishment, Harwell, Eng.); Jones, J. W. S.; Hill, N. A. pp 69-76 of Carbides in Nuclear Energy. Vol. 1. Russell, L. E. (ed.). London, Macmillan and Co., Ltd., 1964. (AERE-R-4456).

Lattice parameters of ThC are reported as a function of C content and annealing conditions. Compacted mixtures of Th and C powders were sintered and annealed under different conditions at temperatures in the range 1000 to 2000°C. Room temperature measurements on specimens annealed for short periods of time in vacuum at 1600°C showed that ThC_x existed as a single phase for values of x of 0.7 to 0.93, the lattice parameter changing from 5.295 to 5.329 Å with

increasing C content. For long annealing times the single phase region was found to exist for values of x from 0.8 to 1.0 with lattice parameters of 5.305 to 5.344 Å. Circumstantial evidence indicates that oxygen solubility is responsible for the lower cell sizes. A comparison of calculated and measured densities was made and the significance of the results is discussed. (auth)

9547 EQUILIBRIA IN THE SYSTEM URANIUM–PLUTONIUM–CARBON. Dalton, J. T. (Atomic Energy Research Establishment, Harwell, Eng.). pp 77-94 of Carbides in Nuclear Energy. Vol. 1. Russell, L. E. (ed.). London, Macmillan and Co., Ltd., 1964.

Studies of the equilibrium phases present up to 2000°C in alloys in the U–Pu–C system containing between 50 and 60 at. % C were made using ceramographic and x-ray diffraction techniques. Complete solid solubility of Pu_2C_3 in U_2C_3 was observed. The raising of the transformation temperature for the reaction $U_2C_3 \rightarrow UC + UC_2$ by Pu additions is described and the composition range over which this transformation occurs is illustrated in an isothermal section at 2000°C. Severe Pu segregation was noted in some arc melted alloys and the time and temperature necessary to eliminate it determined. Some limited data on liquidus temperatures are included. (auth)

9548 THE SOLUBILITY OF OXYGEN AND NITROGEN IN URANIUM CARBIDE. Magnier, P. (Centre d'Etudes Nucleaires de Saclay, Gif-sur-Yvette, France); Trouve, J.; Accary, A. pp 95-107 of Carbides in Nuclear Energy. Vol. 1. Russell, L. E. (ed.). London, Macmillan and Co., Ltd., 1964.

A series of samples containing C, O_2, and U corresponding to the composition $UC_{1-x}O_x$ were prepared. These samples were heat treated at 1800°C in order to bring them as close as possible to equilibrium. Measurements of lattice parameters made at room temperature showed that O_2 can be substituted for C in UC to the extent of x = 0.37. With higher O_2 concentrations UO_2 appears as a second phase. It was observed that the lattice constant of $UC_{1-x}O_x$ solid solutions reaches a maximum value when x = 0.027. For the lower O_2 contents, the specimens used were mixtures of $UC_{1-x}O_x$ and UC_2. No UC_2 was present in the case of the higher O_2 content, even before UO_2 appeared. This fact shows that a reaction such as $2x\ UC_2 + UC_{1-x}O_x \rightarrow (1 + 2x)\ UC + xCO$, takes place for a value of x smaller than 0.37. $UC_{1-z}N_z$ samples were prepared in a manner similar to that used for the preparation of $UC_{1-x}O_x$. Nitrogen can be substituted for C up to proportions corresponding to z = 1. The curve of lattice parameter versus composition of these samples does not display any maximum as in the case of $UC_{1-x}O_x$, but does show a positive deviation from Vegard's law. The room temperature lattice parameter of $UC_{1.00}$ was determined as 4.9597 ± 0.0004 Å. (auth)

9549 ANOMALOUS THERMAL EXPANSIONS IN THE PLUTONIUM MONOCARBIDE REGION. Rand, M. H. (Atomic Energy Research Establishment, Harwell, Eng.); Street, R. S. pp 108-12 of Carbides in Nuclear Energy. Vol. 1. Russell, L. E. (ed.). London, Macmillan and Co., Ltd., 1964.

The cell parameter of two plutonium carbide alloys of low C content, prepared by powder metallurgical techniques at 1500°C, was shown to exhibit a series of abrupt irreversible increases totalling 0.007 Å, on being heat cycled between room temperature and 450°C; thereafter, their expansion between 20° and 700°C is normal. A third sample, within the homogeneity range of the monocarbide, gave a straightforward expansion curve, with a coefficient of expansion of 10.6×10^{-6}/°C. The anomalous expansion may be due to an internal atomic rearrangement of a retained high temperature phase. (auth)

9550 ON THE SYSTEM (UPu)(CNO) AS APPLIED TO SINTERED CARBIDES CARBONITRIDES AND OXYCARBIDES. Anselin, F. (Centre d'Etudes Nucleaires de Fontenay-aux-Roses, Seine, France); Dean, G.; Lorenzelli, R.; Pascard, R. pp 113-61 of Carbides in Nuclear Energy. Vol. 1. Russell, L. E. (ed.). London, Macmillan and Co., Ltd., 1964.

The preparation of completely single phase UC is a difficult problem; the slightest deviation from the stoichiometric ratio results in the formation of a second phase, either U metal or one of the higher carbides. This problem is considered in the more general context of a monocarbide phase of the type $M(C_xN_yO_z)$ where M indicates any U–Pu composition and y and z are the atomic fractions of C replaced by N_2 and O_2 respectively. This phase can be considered as a ternary solid solution of MC–MN–MO. (W.L.G.)

9551 THE SUBSTITUTIONAL SOLUBILITY OF OXYGEN IN U–C, $(U_{0.85}Pu_{0.15})$–C AND Pu–C. Brett, N. H. (Atomic Energy Research Establishment, Harwell, Eng.). Harper, E. A.; Hedger, H. J.; Pottinger, J. S. pp 162-83 of Carbides in Nuclear Energy. Vol. 1. Russell, L. E. (ed.). London, Macmillan and Co., Ltd., 1964.

Studies on the formation of UC_xO_y in compacts of powdered U, UO_2, and graphite heated in vacuum to temperatures of 1100 to 1500°C are described. Ceramographic, x ray, and chemical analyses of the products showed the limiting O_2 content under these conditions to correspond to approximately $UC_{0.7}O_{0.3}$, the lattice parameter decreasing from about 4.96 to 4.95 Å with increasing O_2. Similar techniques were used to study the solution of O_2 in powders of U–C, $(U_{0.85}Pu_{0.15})$–C and Pu–C during heat treatment in Ar at 1500°C, the O_2 being introduced by exposure of the powder to Ar of controlled impurity content before heat treatment. Under these conditions the limit of O_2 solubility in U–C and $(U_{0.85}Pu_{0.15})$–C is about 0.25 wt % while Pu–C dissolved 1 wt % O_2. (auth)

9552 CONSTITUTION OF THE SYSTEMS OF URANIUM AND CARBON WITH MOLYBDENUM, NIOBIUM, RHENIUM, TUNGSTEN, AND YTTRIUM. Chubb, W. (Battelle Memorial Inst., Columbus, Ohio); Keller, D. L. pp 208-30 of Carbides in Nuclear Energy. Vol. 1. Russell, L. E. (ed.). London, Macmillan and Co., Ltd., 1964.

Details of the ternary constitutional diagrams of various metals with U and C are presented. Isothermal sections at 1500°C are presented for the systems, U–C–Mo, U–C–Re, U–C–W, and U–C–Y. A tentative binary constitutional diagram for the Y–C system is developed. Ternary isothermal sections at 1300, 1700, and 2200°C are presented for the U–C–Nb system. (auth)

9553 PHASE RELATIONSHIPS IN THE SYSTEMS U–Cr–C, U–Ni–C AND U–Fe–Cr–C. Briggs, G. (College of Advanced Technology, Sheffield, Eng.); Dutta, S. K.; White, J. pp 231-45 of Carbides in Nuclear Energy. Vol. 1. Russell, L. E. (ed.). London, Macmillan and Co., Ltd., 1964.

Phase equilibrium relations, including melting relations, were investigated in the ternary systems U–Cr–C and U–Ni–C and in the section UC–Fe–Cr of the quaternary system, using a quenching technique. In the system U–Cr–C, the joins UC–Cr, UC–$Cr_{23}C_6$, UC–Cr_7C_3, UC–$UCrC_2$ and $UCrC_2$–Cr_7C_3 were established. The phase boundaries on the liquidus surface in the partial system UC–Cr_7C_3–Cr were also determined. In the system U–Ni–C, the incompatibility in the solid state between UC and Ni was confirmed and certain features of the liquidus surface investigated. The section UC–Fe–Cr of the system U–Fe–Cr–C is unusual in that while Fe and Cr are both compatible with UC in the solid state, Fe–Cr solid solutions react with it to form UFe_2 and a $Cr_{23}C_6$ phase, probably containing some Fe in solid solution. The limits of the primary phase fields in the section were established. (auth)

9554 AN INVESTIGATION OF THE U–C–Fe AND Pu–C–Fe TERNARY PHASE DIAGRAMS WITH SOME OBSERVATIONS ON THE U–Pu–C–Fe QUATERNARY. Nichols, J. L. (Atomic Energy Research Establishment, Harwell, Eng.); Marples, J. A. C. pp 246-60 of Carbides in Nuclear Energy. Vol. 1. Russell, L. E. (ed). London, Macmillan and Co., Ltd., 1964.

The basic features of the U–Fe–C ternary diagram have been previously investigated by workers at Sheffield University, but although present work confirmed these, the

eutectic temperatures were slightly different. Replacing 15 and 30 at. % of the U by Pu in general caused little change in the diagram, the temperatures involved usually being slightly lower. When stainless steel was substituted for Fe the changes occurring were considerably greater, and liquid appeared at a temperature over 100°C lower than in the ternary. The Pu–Fe–C ternary was found to be quite different from the U–Fe–C diagram due to the lower stability of PuC compared with UC and to the existence of a second ternary compound. The latter has a bcc structure with a lattice parameter of 10.10 Å and occurs at approximately 42 at. % C, 33 at. % Fe and 25 at. % Pu. (auth)

9555 A STUDY OF PHASE RELATIONSHIPS IN THE URANIUM–SILICON–CARBON SYSTEM. Smith, G. V. (The Plessey Co., Ltd., Caswell, Eng.); Smith, R. G.; Thomas, A. G. pp 261-5 of Carbides in Nuclear Energy. Vol. 1. Russell, L. E. (ed.). London, Macmillan and Co., Ltd., 1964.

The reactions occurring at high temperatures between UC or UC_2 and SiC were studied by heating premixed powders for short periods followed by rapid cooling. The products were examined by x-ray techniques and two hitherto unreported phases, designated A and X, were observed. Only small amounts of phase A appeared, but phase X was found in considerable quantities in many cases. Chemical separation and analysis were investigated without success. An alternative preparative route was therefore sought via uranium silicides. Reaction of the latter with C gave substantial amounts of phase X. Chemical treatment of the mixed reaction products again failed to establish the composition of phase X, but several structural modifications of the silicides were noted and compared with those reported in the literature. X-ray powder data are presented for phase X and it is suggested that the phase is a ternary compound of U, Si, and C. (auth)

9556 STUDIES IN THE SYSTEM URANIUM CARBIDE–URANIUM SULPHIDE. Shalek, P. D. (Argonne National Lab., Ill.); White, G. D. pp 266-72 of Carbides in Nuclear Energy. Vol. 1. Russell, L. E. (ed.). London, Macmillan and Co., Ltd., 1964.

Phase relations, as a function of temperature and composition, were determined for the system UC–US. The solid solubility of US in UC was limited to 6 mole %, decreasing with temperature, with a proportional increase in unit cell size for the solid solution. UC dissolved in US up to at least 30 mole % with a decrease in cell size proportional to the UC content. The intermediate region contained two solid solutions. Melting temperatures determined across the system indicated a maximum melting composition in the range 30–40 mole % UC, a shallow eutectic at 8 mole % US, and a minimum melting solid solution at 5 mole % UC. The compatibilities of UC and a UC-rich solid solution with several cladding materials were determined qualitatively. (auth)

9557 HIGH TEMPERATURE PROPERTIES OF URANIUM CARBIDE. DeCrescente, M. A. (Pratt and Whitney Aircraft—CANEL, Middletown, Conn.); Miller, A. D. pp 342-57 of Carbides in Nuclear Energy. Vol. 1. Russell, L. E. (ed.). London, Macmillan and Co., Ltd., 1964.

Experimental data pertaining to the thermal decomposition, heat capacity, thermal conductivity, thermal diffusion, and hot hardness of sintered U–C are presented. The data are reviewed in light of impurity and stoichiometry variations, the experimental methods, and comparisons with published results. (auth)

9558 THERMAL CONDUCTIVITY OF URANIUM MONOCARBIDE. Wheeler, M. J. (General Electric Co., Ltd., Wembley, Eng.). pp 358-64 of Carbides in Nuclear Energy. Vol. 1. Russell, L. E. (ed.). London, Macmillan and Co., Ltd., 1964.

Two methods for determining thermal conductivities at high temperatures are described. One method is direct and the other is indirect, the thermal conductivity, k, being derived from the thermal diffusivity, κ. Measurements were made on arc-cast and also on sintered uranium–carbon alloys at or near the UC composition. The results were as follows: for an arc-cast 49.5 at.% C alloy, κ rises nonlinearly from 0.049 cm^2/sec at 1400°K to 0.067 cm^2/sec at 2200°K and remains constant for further increases in temperature. For an arc-cast 51 at.% C alloy, κ is constant at 0.051 cm^2/sec, standard error ±0.001 cm^2/sec, between 1460 and 2360°K. For an arc-cast 52 at.% C alloy, κ is constant at 0.044 cm^2/sec, standard error ±0.001 cm^2/sec between 1640 and 2380°K. Assuming the specific heat of all the alloys to be 0.05 cal/g°K, then at 2300°K, for a 49.5 at.% C alloy k is 0.19 W/cm°K, for a 51 at.% C alloy k is 0.15 W/cm°K, for 52 at.% C alloy k is 0.12 W/cm°K, and for sintered UC, 94% of the theoretical density, k is 0.16 W/cm°K. (auth)

9559 THE COMPRESSIVE-CREEP OF URANIUM MONOCARBIDE. Norreys, J. J. (General Electric Co., Ltd., Wembley, Eng.). pp 435-44 of Carbides in Nuclear Energy. Vol. 1. Russell, L. E. (ed.). London, Macmillan and Co., Ltd., 1964.

Tests were made on samples of UC of differing stoichiometry and purity in the temperature range 1000 to 1500°C under stresses of up to 6000 psi. The apparent activation energy for creep of slightly hyperstoichiometric monocarbide (4.9 wt% C) was determined as 49 ± 8 kcal/mole over the temperature range 1200 to 1400°C. This figure is close to the activation energies for self-diffusion of U and C in UC. Small amounts of free U markedly increase creep rates. Small additions of W were shown to improve considerably the creep resistance of hyperstoichiometric alloys. (auth)

9560 ZIRCONIUM ALLOY. Roesler, Ulrich (to Siemens-Schuckertwerke A G). German Patent 1,202,985. Oct. 14, 1965. Filed Sept. 29, 1962.

A zirconium alloy was developed for nuclear reactors. It is composed of 0.005 to 1.0% cerium, 0.1 to 5% niobium, and, preferentially, of at most 5% tin, copper, iron, chromium, nickel, molybdenum, tungsten, vanadium, tantalum, and/or palladium, respectively, with the rest zirconium. (Gmelin Inst.)

9561 ZIRCONIUM ALLOY. Roesler, Ulricht (to Siemens-Schuckertwerke A G). German Patent 1,202,986. Oct. 14, 1965. Filed Sept. 29, 1962.

A zirconium alloy for nuclear reactors is composed of 0.005 to 1.0% yttrium, 0.1 to 0.5% niobium, of, preferentially, 5% tin, copper, iron, chromium, nickel, molybdenum, tungsten, vanadium, tantalum, and/or palladium respectively, and of zirconium. (Gmelin Inst.)

Radiation Effects

See also CHEMISTRY — Radiation Chemistry

Refer also to abstracts 9254, 9309, 9618, and 9893.

9562 (AE–206) RADIATION INDUCED REMOVAL OF STACKING FAULTS IN QUENCHED ALUMINIUM. Bergenlid, Ulf (Aktiebolaget Atomenergi, Stockholm (Sweden)). Dec. 1965. 11p. Dep. mn.

The effects of neutron irradiation on specimens of quenched aluminum containing Frank sessile dislocation loops were studied by means of electron microscopy. The Frank loops were found to transform into perfect loops at doses less than 10^{17} nvt. A possible reason for the removal of the stacking faults is the displacement of a number of atoms at the faults, leading to the passage of a Shockley partial. Unfaulting induced by stress fields from dislocations, released during the irradiation, is also important. (auth)

9563 (BMI-X-10152) IRRADIATION OF MATERIALS AND ELECTRICAL COMPONENTS AT ELEVATED TEMPERATURES IN A VACUUM FOR THE SNAP-8 REACTOR SYSTEM. Basham, Sam J.; Zielenbach, William J.; Gruber, H. Thomas; Allgeier, Joseph P. Jr. (Battelle Memorial Inst., Columbus, Ohio). Dec. 27, 1965. Contract W-7405-eng-92. 44p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Electrical components and structural materials were irradiated to integrated fast-neutron exposures up to 2×10^{19} n per cm^2 in a high-vacuum environment ($<10^{-5}$ torr) with specimen temperatures maintained at specified levels in the 700 to 1350°F range to obtain radiation-effects data for the SNAP-8 program. Two experiments were conducted; 71 samples were exposed in the first (Experiment HF-8) and 22 in the second (Experiment HF-9). Nuclear environments were measured by extensive pre- and postirradiation dosimetry. The electrical and operating characteristics of the specimens were periodically monitored during the irradiation. The data were studied for interpretation and use in the SNAP-8 program systems development. (auth)

9564 (BNWL–161) BORONATED GRAPHITE IRRADIATION STUDIES SUMMARY REPORT OF THERMAL-NEUTRON-SHIELDED EXPERIMENTS CONDUCTED IN THE ETR. Gates, L. O.; Neidner, R. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Oct. 1965. Contract AT(45-1)-1830. 16p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

A program of irradiation testing was conducted in the ETR to determine the dimensional stability characteristics of four types of boronated graphite after neutron exposure. The materials tested were composed of a nuclear-graphite matrix containing boron carbide in sufficient quantity to give nominal boron concentrations of either 5 or 7 wt %. A discussion of the experimental procedure and results is presented. (M.O.W.)

9565 (BNWL–166, pp 3.10-14) RADIATION EFFECTS ON METALS. Brimhall, J. L.; Kissinger, H. E.; Mastel, B.; Smidt, F. A. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Initial investigations by electron microscopy of irradiated high purity Ni show the presence of small defect clusters ≃75 to 150 Å in dia after irradiations of 2.5×10^{18} nvt. Significant annealing of the radiation damage occurs at temperature of 400°C and above, as shown by the growth of dislocation loops and the reduction in the number of spot defects. Analogies can be made between the irradiation damage and postirradiation annealing behavior in Ni and Mo. An X-ray low-angle scattering apparatus was installed and experimentation begun. Significant low-angle scattering was not found in high purity Mo until after doses of 1×10^{20} nvt were obtained. Low angle scattering was observed in both unirradiated and irradiated Mo containing 100 to 200 ppm C. The presence of carbide precipitates may be contributing to the low angle scattering, but the effect of double Bragg reflection cannot be ruled out. (auth)

9566 (BNWL–166, pp 3.15-23) DAMAGE MECHANISMS. Smidt, F. A.; Laidler, J. J. (Battelle-Northwest, Richland Wash. Pacific Northwest Lab.).

Analysis of thermally activated deformation in neutron irradiated Fe and Mo indicates that obstacles which block thermally activated motion of dislocations are submicroscopic. Larger defects, ~50 Å in dia, revealed by transmission electron microscopy, contribute primarily to the long range athermal stresses. The changes in activation volume during deformation are compatible with dislocation motion confined to localized regions. (auth)

9567 (BNWL–166, pp 3.24-9) SWELLING OF IRRADIATED FISSIONABLE MATERIALS. Brimhall, J. L.; Leggett, R. D.; Mastel, B.; Merckx, K. R.; Taylor, H. A. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

The effect of 1000 vs 20 psi pressure on the radioinduced swelling of U with and without additives at a temperature of 625°C was evaluated. The effect of pressure decreases in the order: high purity U, U–Fe–Si, and U–Fe–Al–Si. (W.L.G.)

9568 (BNWL–166, pp 4.1-7) IN-REACTOR MEASUREMENTS OF MECHANICAL PROPERTIES. Williams, J. A.; Nyman, D. H.; Carter, J. W. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

In-reactor and out-of-reactor creep rates of 3.3 and 2.5×10^{-6}/hr were measured for annealed type 304 stainless steel after 2500 hr of testing at 550°C and 30,000 psi stress. Specimen failure after 2800 hr was observed at a reduced creep-rupture life since the unirradiated creep test is continuing after 4000 hr. The creep rate measured in-reactor for annealed Zircaloy-2, tested at 315°C and 15,000 psi, is on the border of 1 to 4×10^{-7}/hr. This rate was determined after 1000 hr of testing during which time considerable power fluctuations in the PRTR were encountered. No significant differences in creep rates during reactor outages as compared to reactor operating periods were observed. The creep rate of the out-of-reactor control test was 1.9×10^{-7}/hr. It might well be assumed that under the conditions of this test there is little effect of irradiation on the creep of annealed Zircaloy-2. Results of creep rupture tests on Hastelloy X at 1950 and 2100°F are given. The low stress, high temperature decrease in rupture life and minimum creep rate of this alloy in vacuum is explained on the basis of two competing processes: oxidation strengthening, and, reduction in strength due to a lowering of the surface energy. Air strengthening can be due to one or more processes. Surface oxidation may act as a barrier to dislocations, while internal oxidation reduces the stress concentration by blunting a crack tip. Surface energy effects due to gas adsorption do not play a major role in this investigation since the tests were carried out in vacuum at pressures to 5×10^{-5} torr. At low stresses and high temperatures there is a definite decrease in rupture life and minimum creep rates. As Hastelloy X is an oxidation resistant alloy, a very high temperature of transition to air strengthening at reasonable rupture times would be expected. (W.L.G.)

9569 (BNWL–166, pp 6.1-3) PRTR PRESSURE TUBES. Fraser, M. C. (Battelle-Northwest, Richland, Wash. Pacific Northest Lab.).

Study and testing of the ability of the PRTR Zircaloy-2 pressure tubes to sustain the PRTR reactor system loads with ever-increasing neutron exposure consisted of: tensile testing of ring specimens after annealing at 550°F for 2000 hr, a burst test and a crack propagation test of specimens taken from a discharge tube, and measurement of elastic hoop and axial strain on an unirradiated tube specimen during simultaneous application of pressures and axial loads. The tests indicated that 2000 hr at 550°F did not significantly alter the ring tensile properties as irradiated to 5×10^{20} fast nvt (E > Mev), that the burst test and crack propagation failure pressure were equal to or greater than those for specimens having less exposure, and that comparison of the measured strains with calculated strains for a theoretical isotropic body was evidence of anisotropy of the Zircaloy-2 specimen. (auth)

9570 (CONF-650620, pp 47-84) EVALUATION OF NON FUEL MATERIAL BEHAVIOR IN HNPF. Wagner, R. K.; Stearns, J. D. (Atomics International, Canoga Park, Calif.).

The examination of a failed sodium expansion tank for the HNPF is described. The primary leak was caused by stress-corrosion cracking. The cracking occurred in an area of high stress where a cavity, containing a highly corrosive deposit, existed. The deposit was identified as residual flux from coated welding electrodes. The swelling characteristics of irradiated and unirradiated graphite when impregnated by sodium were determined. Unirradiated extruded graphite expanded about 1% when exposed to sodium at 600 to 1200°F. The expansion of irradiated graphite in sodium increased with accumulated neutron dose, but the expansion was not temperature dependent upon sodium exposure temperatures between 800 and 1200°F. Bulk expansion to 5% was found when highly irradiated (10^{21} nvt) TSP graphite was exposed to sodium. The greater expansion of the irradiated graphite upon exposure to sodium was attributed to sodium intercalation of the basal layers expanding the c-axis. The bulk dimensional expansion of the irradiated graphite in sodium is anisotropic, greater expansion being observed normal

to the direction of extrusion. The c-spacing lattice dimensions partially recovered when sodium-logged graphite was exposed to air, but the bulk expansion remained essentially constant due to the formation of sodium–oxygen compounds. (W.L.G.)

9571 (COO-1367-1) ON THE INTERRUPTION YIELD POINT OF IRRADIATED ALUMINUM SINGLE CRYSTALS. (Northwestern Univ., Evanston, Ill.). [1964]. Contract AT(11-1)-1367. 9p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

Aluminum single crystals of 99.999% initial purity were irradiated at about 86°K with electrons having an incident energy of 1 Mev to a total dose of 5×10^{17} e/cm^2. It was found that the impurity trapped interstitials first form an atmosphere around the dislocations and later precipitate in the form of superjogs. This causes a transition from an interruption yield point to a flow stress increase as the time of the interruption is lengthened. The aging process was also attributed to interstitial diffusion. (P.C.H.)

9572 (DP-994) IRRADIATION BEHAVIOR OF Zr–U DRIVER TUBES FOR HWCTR. Angerman, Carl L.; Caskey, George R. Jr. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). Oct. 1965. Contract AT(07-2)-1. 18p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

The HWCTR was fueled with enriched uranium tubes of Zr–9.3 wt % U alloy clad with Zircaloy-2 by coextrusion. Irradiation of these tubes up to 1.83 atom % burnup at temperatures up to 540°C and under 1200 psi coolant pressure resulted in volume increases up to 5%, only about half of the amount predicted by published data. The volume increases were caused by the formation of solid fission products and the precipitation of fission gases in small bubbles. (auth)

9573 (EURAEC-1455) THE SHAPING AND IRRADIATION OF URANIUM MONOCARBIDE. Quarterly Report No. 15, July 1, 1964–March 31, 1965. Dumas, J. P.; Mansard, B. (Commissariat a l'Energie Atomique, Paris (France)). Contract 080-62-3-RDF. 51p. (EUR-2385). Dep. mn. CFSTI $3.00 cy, $0.50 mn.

Work Performed Under United States–Euratom Joint Research and Development Program.

Comparison of UC samples, prepared by reaction sintering and containing small amounts of UO_2, indicated that reactor irradiation catalyzed the reaction between C and UO_2 producing CO, which in turn produced swelling. The form of the O_2 content appeared more important than the quantity; U(CO) appeared to be nonreactive. Pellets, which were heated to 1000°C by electronic bombardment to an exposure of 140 Mwd/t, were densified by 1.91 to 2.43%. (W.L.G.)

9574 (EURAEC-1458) THE SHAPING AND IRRADIATION OF URANIUM MONOCARBIDE. Quarterly Report No. 16, April 1, 1965–June 30, 1965. Dumas, J. P.; Mansard, B. (Commissariat a l'Energie Atomique, Paris (France)). Contract 080-62-3-RDF. 29p. (EUR-2387). Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Work Performed Under United States–Euratom Joint Research and Development Program.

Results of examinations of uranium carbide cylinders irradiated to a burnup of 500 Mwd/t at a temperature equal to or greater than 1000°C are described. (W.L.G.)

9575 (LA-3413) FISSION FRAGMENT REMOVAL OF URANIUM FROM A FISSIONING SURFACE. [PART] II. Peterson, P. J.; Thorpe, M. M. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). Oct. 15, 1965. Contract W-7405-eng-36. 12p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Equipment was designed and built for reactor irradiation of U metal in a controlled and measured vacuum with collection of the U atoms ejected on a surrounding Pt foil. At intervals, the U metal source was withdrawn and kept in vacuo while the Pt foil with the collected U became the high-voltage electrode of a fission counting chamber. Accurate measurements of the relative amounts of U collected on the Pt were made at intervals by fission counting techniques. Exposure of the U metal source to moist He resulted in an acceleration of the U deposition on the Pt with a gradual return toward the rate obtaining before treatment. It is evident from this that the surface condition of the U metal source is an important factor in the ejection of the U atoms from a fissioning surface. (P.C.H.)

9576 (ORNL-3878) RADIATION METALLURGY SECTION, SOLID STATE DIVISION PROGRESS REPORT FOR PERIOD ENDING AUGUST 1965. (Oak Ridge National Lab., Tenn.). Jan. 1966. Contract W-7405-eng-26. 84p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

The precipitation of nitrides in α-Fe was measured using low-frequency internal friction as a measure of the amount of N_2 in solid solution. The rate of precipitation was enhanced by neutron irradiation, but not by electron irradiation. However, if the electron dose was large enough, some evidence for the trapping of N_2 atoms by radiation-produced defects was seen. A Ni–40 wt % Cu alloy was given a series of isothermal anneals following irradiation at –180°C to a dose of 1×10^{17} neutrons/cm^2 (E > 1 Mev). The activation energy for the radiation-enhanced segregation reaction was found to increase during the process, although from 23 to 192°C the energy was fairly constant at 1.2 to 1.3 ev. For a singly activated process, this energy is shown to correspond to the energy for motion of the diffusion-enhancing defect. Radiation hardening in Fe was investigated by stress relaxation techniques. The stress dependence of dislocation velocity for electron and neutron irradiated Fe was quite similar to that for unirradiated material. However, the threshold stress for macroscopic dislocation motion was increased significantly as a result of the irradiation. This factor, rather than the decrease in mobile dislocation density, was chiefly responsible for the radiation hardening in this material. No dose rate effect on the tensile properties was observed for Fe samples given a dose of 1.5×10^{18} neutrons/cm^2 (E > 2.9 Mev) over a range of fluxes and from 4 to 70×10^{11} neutrons cm^{-2} sec^{-1}. Experiments on the strain rate dependence of the yield stress showed that the yield stress asymptotically approaches the threshold stress as the strain rate is decreased. Measurements of lattice rotation in single crystals of Nb during tensile deformation indicated a considerable amount of latent hardening on the secondary slip system. Also, the departure of the orientation of the tensile axis from that predicted for single slip was correlated with the appearance of the slip bands on the surface and an increased rate of work hardening. Characteristic changes in strength and ductility from neutron irradiation were observed. Efforts to reveal mobile dislocations in Nb by etch-pitting techniques were successful. Smooth and notched sheet tensile samples of types 330 and 270 nickel and type 410 stainless steel were irradiated to 10^{21} neutrons/cm^2 and the results of two types of annealing experiments are described. For notched samples of type 330 nickel containing 0.03 wt % C, a large increase in strength was observed upon annealing to 427°C. A smaller increase in strength was also observed for smooth samples, but this irradiation-anneal hardening was not exhibited by any of the other alloys. (W.L.G.)

9577 (VDDIT-16(5.3)) RADIATION EFFECTS ON SOLID, URANIUM BASED NUCLEAR FUEL MATERIALS. Volume 5, Number 3. A Bibliography. Uhlmann, W. (Aktiebolaget Atomenergi, Stockholm (Sweden)). Nov. 1965. 56p. Dep. mn.

Fifty-four references are given to journals and reports published from 1963 through May 1965. The references are arranged under the headings: uranium metal; alloys; carbide; oxide; nitride; dispersion fuels; and coated particle fuels. (W.L.G.)

9578 THE EFFECT OF RADIOLYTIC OXIDATION BY CARBON DIOXIDE ON THE POROSITY OF GRAPHITE. Standring, J.; Ashton, B. W. (United Kingdon Atomic Energy Authority, Culcheth, Eng.). Carbon, 3: 157-65 (Oct. 1965).

The effects of radiolytic oxidation by carbon dioxide on the porosity of A-grade pile graphite (PGA) and also a material of lower initial porosity were studied. Use of in-pile rigs operated at 735 lb/in.^{2} (gage) enabled weight losses up to 29% to be obtained. Results indicated that up to 40% of the originally closed pore volume becomes accessible by 2% weight loss. The pores thus opened are probably similar in character and origin to the original open pores. The remaining closed porosity was removed only in proportion to the graphite consumed, and was tentatively identified with cleavage cracks of the type revealed by electron micrography and also plugged pores with thick cell walls. Proportionality between oxidation rate and accessible pore volume (as found in earlier studies) was again observed except in the case of heavily oxidized specimens. This qualification suggested that ineffective radiolysis of gas occurs at the center of large pores in these cases. (auth)

9579 THE EFFECTS OF RADIATION ON REFRACTORY OXIDES. THE CASE OF URANIUM OXIDE. Delmas, R. (CEA, Paris). Energie Nucl., 7: 354-63(Sept.-Oct. 1965). (In French).

Studies on the modifications in properties of UO_2 by irradiation are reviewed. Changes in crystal structure, thermal conductivity, and the migration of rare gases are discussed. (M.C.G.)

9580 FATIGUE BEHAVIOR OF MAGNOX AL80 AND IRRADIATION EFFECT ON FATIGUE PROPERTIES. Nagasaki, Ryukichi; Shiraishi, Kensuke (Japan Atomic Energy Research Inst., Tokyo). J. Nucl. Sci. Technol. (Tokyo), 2: 450-6(Nov. 1965).

The fatigue behavior of Magnox AL 80 was studied using both fine- and coarse-grained specimens as well as welded specimens. The effects of neutron irradiation on the fatigue properties of Magnox AL 80 were also investigated. (D.C.W.)

9581 IMPURITY DEPENDENCE OF ANNEALING OF γ-RAY IRRADIATED N-TYPE GERMANIUM. Nakazawa, Fumiko; Ishino, Shiori; Higashinakagawa, Iwao; Hasiguti, Ryukiti R. (Tokyo Univ.). J. Phys. Chem. Solids, 26: 1895-1907(Dec. 1965).

Gamma-irradiated n-type germanium doped with neutral impurities such as tin and silicon, together with charged impurities such as antimony and arsenic, was studied by means of isochronal and isothermal annealings. In antimony + tin doped germanium two shallow levels are introduced by γ-ray irradiation. They are situated at 0.14 and 0.20 ev below the conduction band and they anneal in different temperature ranges. In antimony doped germanium a shallow level situated at 0.21 ev below the conduction band is introduced by irradiation and its position changes to 0.25 ev after moderate annealing. Both in arsenic doped and arsenic + silicon doped germanium also, a shallow level is introduced by irradiation and its position is obtained to be 0.25 ev after moderate annealing. Discriminative analyses of temperature dependences of Hall coefficients after successive annealings enable us to separate the annealing of shallow levels from that of deep levels. Separated annealing curves show annealing behaviors of defects more clearly. Each annealing stage is discussed in terms of these separated annealing curves. (auth)

9582 CORRELATED ATOMIC COLLISIONS IN IRRADIATED CRYSTAL LATTICES. Chadderton, Lewis T.; Torrens, Ian McC. (Cavendish Lab., Univ. of Cambridge, Eng.). Nature, 208: 880-2(Nov. 27, 1965).

The problem of fission damage in crystals, and the part which focusing and channeling are likely to play in the different crystal types is investigated. For this purpose a computer program was established in which a section is taken across the crystallite, and the projected orbits of atoms originally at rest on lattice sites in that plane are automatically plotted. Various crystals are considered. The 80-ev correlation diagrams for a struck lead atom in a plane of a hexagonal lead iodide lattice and for a struck potassium ion in potassium chloride are shown. The primary correlation diagram for these events is also shown. A 1,000-ev primary correlation diagram for a struck lead atom in the same plane of the lead iodide lattice is also given. (J.F.P.)

9583 THE MODIFICATION OF THE HARDENING OF AN Al−5 percent Cu ALLOY BY α IRRADIATION. Vogl, G.; Weiss, B. (Univ., Vienna). Oesterr. Akad. Wiss., Math.-Naturwiss. Kl., Anz., 101: 87-98(1964). (In German).

The effects of α irradiation on the hardening of an Al−Cu alloy was studied in two series: irradiation at −50°C before hardening and irradiation during hardening. The results showed that the samples differed in their behavior. Hardening was induced by the irradiation at −50°C, but it did not occur in the unirradiated sample at this temperature. The hardening curves of the irradiated samples at all temperatures show higher hardening values than the curves of the nonirradiated samples. Modifications in the hardening pattern can be induced by the irradiation. (J.S.R.)

9584 CYCLIC STRESS OF METALS WITH SIMULTANEOUS IRRADIATION. Steiner II, H. (Univ., Vienna. Tohoku Univ., Sendai). Oesterr. Akad. Wiss., Math.-Naturwiss. Kl., Anz., 101: 337-54(1964). (In German).

The effects of α irradiation on the expansion of tin and zinc metal crystals undergoing cyclic torsion stress were investigated. The results showed no effect of the superposed radiation within the measurement accuracy. In all cases the results showed an increased hardening with the irradiation. This irradiation effect increases with increasing irradiation time and increasing torsion cycles. (J.S.R.)

9585 ZERO-PHONON LINES IN NEUTRON IRRADIATED MgO CRYSTALS. Kazumata, Y.; Ozawa, K.; Nakagawa, M. (Japan Atomic Energy Research Inst., Tokai-mura). Phys. Lett., 19: 529-30(Dec. 15, 1965).

The observation of sharp resonance peaks in the electronic band structure of MgO single crystals due to impurities or lattice defects when these crystals were irradiated in a reactor at low temperature is reported. Such resonance peaks are associated with the zero-phonon transition in an optical analogy of the Mössbauer effect. The absorption spectrum of the neutron irradiated MgO at 4°K in the visible and ultraviolet regions is shown. The temperature dependence of the relative integrated zero-phonon line of the 352 mμ band in MgO, and the temperature dependence of the half-widths of zero-phonon lines at 361 mμ and 1.04 μ are also shown. (J.F.P.)

9586 RADIATION DAMAGE IN Pt PRODUCED BY 1.8–3.0-Mev ELECTRONS. Burke, E. A.; Jimenez, C. M.; Lowe, L. F. (Air Force Cambridge Research Labs., Bedford, Mass.). Phys. Rev., 141: 629-34(Jan. 1966).

The change in electrical resistivity in Pt, $R(E) = \Delta\rho$/electron cm^2, was measured in the energy range 1.8–3.0 Mev. The experimental values found in this interval are consistent with a displacement threshold of 37 ev, using the Mott equation for relativistically scattered electrons. The resistivity increase per unit integrated flux at 2.0 Mev was found to be 4.6×10^{-26} Ω cm/electron cm^2, which yields 7.5×10^{-4} for ρ_f, the resistivity per unit concentration of Frenkel pairs. (auth)

9587 RADIATION DAMAGE IN MYLAR EXPOSED TO MINIMUM IONIZING PROTONS. Hennessy, J. J.; Moore, W. H. (Brookhaven National Lab., Upton, N. Y.). Rev. Sci. Instrum., 37: 55-8(Jan. 1966).

Mylar D strips were exposed to 10^{16} protons in the circulating beam of the Cosmotron and the deterioration of their mechanical properties as a function of the dose is presented. The breaking strength has a threshold decrease at 1.0×10^{15} and falls to half value at 3.0×10^{15} protons/cm^2. An estimate of the radiation dose was made. (auth)

9588 DETERMINATION OF THE TYPE OF RADIATION TRAPS IN GLASSES. Yudin, D. M. (Vavilov State Optical Inst., Leningrad). Soviet Phys.-Solid State (Engl. Transl.), 7: 1399-1403(Dec. 1965).

Translated from Fiz. Tverd. Tela, 7: 1733-8(June 1965).

Electron paramagnetic resonance spectra are presented for glass with a composition of 15% NaO and 85% SiO_2, prepared under different oxidation-reduction conditions, with a variable concentration of CeO_2. A scheme is proposed for the energy levels corresponding to the hole paramagnetic color centers which are formed in glasses exposed to ^{60}Co gamma rays. (D.C.W.)

9589 RECOMBINATION RADIATION IN GaAs UNDER THE ACTION OF INDIVIDUAL α-PARTICLES. Berkovskii, F. M. (Ioffe Inst. of Physics and Tech., Leningrad). Soviet Phys.-Solid State (Engl. Transl.), 7: 1523-4(Dec. 1965).

Translated from Fiz. Tverd. Tela, 7: 1889-90(June 1965).

Recombination radiation pulses were observed in GaAs irradiated with 5.47-Mev alpha particles from an ^{241}Am source. The amplitude of the radiation pulses was considerably greater in the p-type (zinc-doped) samples than in the n-type samples. The quantum efficiency of the conversion of alpha-particle energy into light energy in the samples was less than 0.1%. (D.C.W.)

9590 THE EFFECT OF NEUTRON IRRADIATION ON THE TENSILE PROPERTIES OF THE Zr–2.5 wt pct Nb (Cb)–0.5 wt pct Cu ALLOY. Ells, C. E. (Atomic Energy of Canada, Ltd., Chalk River, Ont.); Sawatzky, A. Trans. Met. Soc. AIME, 233: 2041-51(Dec. 1965).

The effect of neutron irradiation on tensile properties of the Zr-2.5 wt % Nb-0.5 wt % Cu alloy was evaluated for integrated neutron fluxes up to 3×10^{20} n per cm^2 (E > 1 Mev). Specimen temperature during irradiation was normally 300°C. The material was studied both in annealed and in quenched and aged conditions. When the alloy (fabricated from sponge zirconium) was quenched from a temperature ≈ 40°C below the $\alpha + \beta/\beta$ transformation and aged 6 hr at 535°C, neutron irradiation up to the maximum studied had little effect on reduction in area, although there was a drop in uniform elongation and the yield strength was increased by ~25%. Conversely, irradiation of the alloy in an annealed condition resulted in much greater changes in properties, with yield-strength increases of up to 200%. The dose dependence of irradiation hardening obeyed the saturation equation proposed by Makin and Minter to explain hardening in copper and nickel. A model is proposed to explain the effect of niobium content and metallurgical condition on irradiation behavior. (auth)

9591 THE ENERGY DEPENDENCE OF RADIATION DAMAGE INDUCED IN COPPER BY LOW ENERGY ^1H AND ^4He IONS [Thesis]. Anspaugh, Bruce Edward. Lincoln, Neb., Univ. of Nebraska, 1965. 118p.

Bombardments of nominally 99.995% pure copper foils at 77°K were performed using 50 to 325-kev protons and He^+ ions from the Nebraska Cockcroft-Walton accelerator. Rates of defect production as a function of energy were calculated from measured electrical resistivity changes for each type of ion. Comparison of the experimental values, corrected for low temperature annealing, with the Harrison-Seitz and Neufeld-Snyder theoretical defect production rates shows that theory predicts values 10 to 12 times higher than our measurements at 50 kev for both ions. Agreement becomes better at higher energies with the discrepancy about a factor of 2 to 4 at 300 kev. The relationship between the experimental and theoretical values for the defect production rates was found to be linear. For protons, the relation is $n_{exp} = 0.319\ (n_{the} - 15.3)$, and for He^+ it is $n_{exp} = 0.604\ (n_{the} - 55.1)$, where n is the number of defects per incident particle. Various possible reasons for the disagreement between theory and experiment are discussed. (Dissertation Abstr.)

9592 RADIATION DAMAGE IN UC, UC_2 AND U_2C_3. Childs, B. G. (Dounreay Experimental Reactor Establishment, Caithness, Scotland); Ruckman, J. C.; Buxton, K. pp 849-63 of Carbides in Nuclear Energy. Vol. 2. Russell, L. E. (ed.). London, Macmillan and Co., Ltd., 1964.

The characteristics of radiation damage in UC, UC_2, and U_2C_3 were inferred from the changes in the electrical resistivity, lattice parameter, density and x-ray line breadth of specimens which occur following irradiation and subsequent annealing. For UC irradiated at 50°C to exposures up to about 10^{18} fissions/cm^3 a tolerably complete picture of the damage has emerged. It appears that this consists mainly of U vacancies and interstitial atoms, or small clusters of these, which saturate at a concentration of about 0.35 at. % at 10^{17} fissions/cm^3. Above 10^{18} fissions/cm^3 indications are that the damage becomes more complex in nature with, possibly, an increasing tendency to form larger defect aggregates. The situation for UC_2 and U_2C_3 is less clear, the experimental data obtained so far being insufficient for final conclusions to be drawn. (auth)

9593 IRRADIATION OF Pu–C AND (UPu)–C. Neimark, L. A. (Argonne National Lab., Ill.); Kittel, J. H.; Crothers, C. C. pp 864-78 of Carbides in Nuclear Energy. Vol. 2. Russell, L. E. (ed.). London, Macmillan and Co., Ltd., 1964.

Irradiations were made on arc cast specimens of PuC and UC–PuC and on pressed and sintered pellets of UC–PuC. The PuC content in the mixed carbide specimens was near 20 wt %. The specimens were irradiated as fuel rods in the EBR-I reactor. Maximum fuel burnups and temperatures during irradiation were respectively 0.10 metal atom percent and 650°C. The arc cast PuC specimens were found to have fractured to greater extent than the arc cast mixed carbide specimens. Dimensional changes in the arc cast specimens were negligible. Density changes were both positive and negative in the arc cast PuC specimens, and negative in the mixed carbide specimens. Fission gas release from the arc cast specimens was 0.24% of the theoretical yield. The pressed and sintered specimens did not fracture under irradiation and dimensional changes were negligible. Fission gas release from the pressed and sintered specimens was 12.0% of theoretical. The high gas release is attributed to a relatively high degree of open porosity which existed in the pellets. (auth)

9594 IRRADIATION EFFECTS IN U–C AND (UPu)–C FUEL PELLETS. Bradbury, B. T. (Atomic Energy Research Establishment, Harwell, Eng.); Cole, J. E.; Frost, B. R. T.; Lambert, J. D. B. pp 879-95 of Carbides in Nuclear Energy. Vol. 2. Russell, L. E. (ed.). London, Macmillan and Co., Ltd., 1964.

Miniature fuel elements comprising stainless steel clad carbide fuel pellets were irradiated to determine their irradiation characteristics at moderate temperatures and burnups. Four of the elements consisted of 0.1 in. dia arc-cast $(U_{0.9}Pu_{0.1})C$ pins that achieved measured burnups of between 2.26×10^{20} and 6.57×10^{20} fissions/cm^3 at center temperatures of between 480 and 1010°C. The remaining five elements were made up of three containing 0.1 in. dia singered UC pellets and two containing 0.1 in. dia sintered UC–10 wt % UFe_2 pellets. The UC elements were irradiated to burnups of 1.34×10^{20} and 2.33×10^{20} fissions/cm^3 at estimated center temperatures of 570°C, while the UC–10 wt % UFe_2 pellets achieved measured burnups of 2.83×10^{20} and 4.39×10^{20} fissions/cm^3 at center temperatures of 580°C. In all cases, fission gas release values were very low, and of the same order as, or less than, the calculated release values based on surface recoil. Apart from irregular patterns of microcracking, none of the microstructures of the carbides were changed by irradiation. (auth)

9595 EFFECTS OF FABRICATION AND COMPOSITION ON THE IRRADIATION STABILITY OF URANIUM CARBIDE. Crane, J. (United Nuclear Corp., New Haven); Gordon, E. pp 896-918 of Carbides in Nuclear Energy. Vol. 2. Russell, L. E. (ed.). London, MacMillan and Co., Ltd., 1964.

Three instrumented capsules UNC-1-1, UNC-1-2, UNC-1-3, were prepared. Each capsule contained five, 12% enriched, uranium carbide specimens as follows: $UC_{0.9}$ sintered, UC sintered, $UC_{0.9}$ cast, UC cast, and $UC_{1.09}$ cast. The powder metullurgy specimens were made of alkane reaction produced powder. The specimens were clad in Nb–1 wt % Zr. Capsules UNC-1-1 and UNC-1-2 were sodium bonded, and UNC-1-3 was mechanically bonded. Capsules UNC-1-2 and UNC-1-3 were irradiated to burnups of 1.12 ×

10^{21} fissions/cm^3 (28000 Mwd/teU) and 6.8×10^{20} fissions/cm^3 (17000 Mwd/teU) respectively. Fuel surface temperatures were 660, 800, and 715°C respectively, with an estimated thermal gradient from centerline to surface of about 400°C. Capsule UNC-1-1 is continuing to a burnup in excess of 1.4×10^{21} fissions/cm^3 (35000 Mwd/teU). Post irradiation examination showed that fission gas release was as much as an order of magnitude greater, and density decrease as much as four times greater for hypostoichiometric carbide as compared to stoichiometric or hyperstoichiometric. In general, arc cast material showed greater irradiation stability than sintered material with the one exception that sintered UC mechanically bonded showed the least density decrease of all specimens tested. Details of dimensional changes, fission gas release, microstructural changes and clad/fuel interaction are given. A description of the specimens, capsule and conditions of test are given. (auth)

9596 THE IRRADIATION BEHAVIOR OF COATED PARTICLE FUEL. Sayers, J. B. (Atomic Energy Research Establishment, Harwell, Eng.); Rose, K. S. B.; Coobs, J. H.; Hauser, G. P.; Vivante, C. pp 919-62 of Carbides in Nuclear Energy. Vol. 2. Russell, L. E. (ed.). London, Macmillan and Co., Ltd., 1964.

Irradiation experiments were carried out on a variety of carbide fuels coated with either pyrocarbon or composite pyrocarbon-SiC coatings. Both static capsule and gas cooled loop experiments were performed covering a range of burnups up to 14% of initial metal atoms. In the higher burnup range, covering up to 14% of initial metal atoms (2×10^{21} fissions/cm^3), all the particles had fully enriched sintered UC_2 kernels with porosities in the range 30-50%. They were coated with two or three distinct pyrocarbon coatings, and tested both in compact form and as unsupported particles. The results show that this type of particle can withstand a burnup of 8% at temperatures below 1300°C with very low failure rate. Above 8% burnup the data are solely from particles in compacts and although failure can normally be attributed to an advanced form of spearhead attack, there is also some evidence to suggest that this had been aggravated by external corrosive effects. In the lower burnup range, up to 2.6% of initial metal atoms (3×10^{20}-10^{21} fissions/cm^3 depending on kernel type and density), both sintered and melted $(ThU)C_2$ and melted (ZrU)C particles coated with a triplex pyrocarbon coat were irradiated at temperatures up to 1400°C only in compact form. Sintered (ZrU)C particles coated with various types of pyrocarbon coatings were irradiated similarly at temperatures up to 1700°C. The melted $(ThU)C_2$ kernels cracked under irradiation causing stress cracking in all the coating layers, whereas in the sintered type no failed coatings were found nor were any diffusional effects observed in the SiC layer. The melted (ZrU)C kernels did not show this cracking, but metallographic examination showed them to be polycrystalline and less dense than the Th containing kernels. No diffusion of the sintered (ZrU)C into the pyrocarbon coating was observed in spite of the high irradiation temperatures. Only tentative comparisons between pyrocarbon and composite pyrocarbon-SiC as coatings, or UC_2 as opposed to alloyed kernels are possible with the present data, as the burnup and temperature ranges covered hardly overlap. Two phenomena that appear to have a marked influence on particle behavior are discussed in some detail: The occurrence of a low temperature sintering phenomenon attributable to irradiation. The so-called spearhead attack in pyrocarbon that is tentatively ascribed to fission fragment recoil damage causing ordering and possibly graphitization of the pyrocarbon, resulting in a shrinkage. The initiation of the cracks in the pyrocarbon coating may be due to chemical attack by fission products. (auth)

PHYSICS

General

Refer also to abstracts 9092, 9597, and 10276.

9597 (ANL–7029) PHYSICS DIVISION SUMMARY REPORT, JANUARY–MARCH 1965. (Argonne National Lab., Ill.). Contract W-31-109-eng-38. 49p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

Separate abstracts were prepared for the 6 included sections. (M.O.W.)

For abstracts of individual sections see: 8962, 9244, 9608, 9788, 9961, and 9962.

9598 (CONF-650512, pp 156-61) PRODUCTION OF LARGE-VOLUME MAGNETIC FIELDS BY EXPLOSIVE GENERATORS. Cummings, D. B. (Aerojet-General Nucleonics, San Ramon, Calif.).

Explosive generators are devices in which explosive energy is converted directly into electromagnetic energy. This is done by making an explosive-driven conducting wall perform work by compressing a magnetic field. Because of the high stored energy density of explosives, these devices can be relatively small and lightweight. A technique is described which allows coupling of one or more loops to an explosive generator which transforms the inductance of the loop(s) to an arbitrarily small value. Consequently, the lossless gain of an explosive generator driving a large loop can be made 1000 or more. With this technique magnetic fields can be produced in very large volumes limited only by the energy capability of the explosive generator. Test results are presented. (M.O.W.)

9599 (LA-DC–6559) A LOCAL LAGRANGE FORMALISM. Kiehn, R. M. (Los Alamos Scientific Lab., Univ. of California, N. Mex. Houston Univ., Tex. Dept. of Physics). July 27, 1964. Contract W-7405-eng-36. 7p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

The Lagrange-Euler equations are developed from a differential, local view point, yielding the explicit effects of curvature tensor on the trajectories of motion and the stress energy tensor. (auth)

9600 CONTROLLED FIGURING OF OPTICAL SURFACES BY ENERGETIC IONIC BEAMS. Meinel, A. B. (Univ. of Arizona, Tucson); Bashkin, S.; Loomis, D. A. Appl. Opt., 4: 1674(Dec. 1965).

It is reported that a beam of heavy ions at 1 Mev nominal machine energy effected a uniform removal of a surface of fused silica upon which the beam impinged. The scattering of a laser beam by the surface confirmed that the ion-figured surface was polished as well or better than the original surface. It is concluded that the figuring of optical surfaces to great accuracy can be done using a directed beam of positive ions. (J.F.P.)

9601 SELF-ACCELERATION OF IONIZING PARTICLES IN AN ELECTRIC FIELD OF A POLARIZING IONIZATION LOOP. Askar'yan, G. A. (Lebedev Physics Inst., Academy of Sciences, USSR). JETP Lett. (USSR) (Engl. Transl.), 2: 113-15(Aug. 15, 1965).

Conditions for the acceleration of particles by means of a field of an ionization loop both in the presence and in the absence of breakdown are considered. The case of non-breakdown polarization, when the cascade does not have time to develop within the time when the strong edge field is crowded out, is treated. It is shown that it is possible, at least in principle, to accelerate ionizing bunches of particles in a medium with an electric field without increasing the ionization concentration in the trail to breakdown values. Also the extent to which the breakdown-induced increase in the plasma-trail concentration can be effectively utilized to reduce the necessary number of particles in the accelerated bunch is examined. (J.F.P.)

9602 ON THE PAIR HAMILTONIAN FOR AN IMPERFECT BOSON GAS. Pethick, C. J.; Ter Haar, D. (Oxford Univ.). Phys. Lett., 19: 20-1(Sept. 15, 1965).

Luban's treatment of the properties of a boson gas with a pair hamiltonian is discussed for temperatures below the transition temperature for which there is a Bose-Einstein condensate. A method for making Luban's solution exact is outlined. (G.O.Y.)

9603 QUANTUM CORRECTIONS TO CRITICAL-POINT BEHAVIOR. Fisher, Michael E. (London Univ.). Phys. Rev. Lett., 16: 11-14(Jan. 3, 1966).

An attempt was made to show that the ideal critical-point exponents involving the de Boer parameter (Λ^*) are probably discontinuous functions of Λ^* when $T \to T_c$.(G.O.Y.)

9604 QUANTUM THEORY OF MANY-BODY SYSTEMS. Hugenholtz, N. M. (Univ., Groningen, Netherlands). Rep. Progr. Phys., 28: 201–47(1965).

A survey is given of the present status of the quantum theory of many-particle systems with special emphasis on the underlying principles. Very little is said about applications. A brief introduction to some models, which are of interest for an approximate or qualitative description of actual physical systems, is followed by a discussion of two important phenomena in many-particle systems: quasi-particles and collective excitations. Next, an outline is given of mathematical methods which were used for a precise treatment of such phenomena. A rather thorough discussion of the Bogoliubov model for interacting bosons, and the BCS model for fermions, serves as an illustration. Some new features, typical of many-particle systems, are discussed on the basis of these models. Also another approach to the many-body problem is discussed which is more logical and mathematically more rigorous. This approach differs from standard procedures in that the limit $\Omega \to \infty$, $N \to \infty$ is not taken at the end of the calculations but in the beginning. This quantum theory of infinite systems leads, among other things, to a better understanding of the models mentioned above. (auth)

9605 SAHA INSTITUTE OF NUCLEAR PHYSICS BULLETIN 1961–1964. Saha Inst. Nucl. Phys. Bull., 1961–1964, 1-82(1965).

A description is given of the Saha Institute of Nuclear Studies. A historical background is given, and the work of the institute is described. A brief review of the progress of the institute is given including the gas electronics group, accelerator, nuclear physics, biophysics, nuclear chemistry, instrumentation, theoretical, nuclear physics, and teaching divisions. The workshop and library sections are also described. (J.F.P.)

9606 MERNOEK-FIZIKUSOK ZSEBKOENYVE. (Engineering Physics Handbook). Fjodorov, N. D. Budapest, Mueszaki Koenyvkiado, 1964. 442p.

Equations and data tabulations pertinent to neutron physics, reactor engineering and theory, plasma physics and thermonuclear reactions, dosimetry of ionizing radiation, radiochemistry and radiation chemistry, and mathematical physics are included. (R.V.J.)

9607 HIGH SPEED PULSE TECHNOLOGY. Volume I. Capacitor Discharges—Magnetohydrodynamics—X-Rays—Ultrasonics. Fruengel, Frank B. A. New York, Academic Press, 1965. 631p. $24.00.

A comprehensive study of capacitors and their circuitry in relation to high-voltage and high-current pulses is presented. Discussions are given of capacitor characteristics and applications in a discharge circuit; switching means; line conductors; conversion of capactor energy into current impulses, voltage impulses, x-ray flashes and neutrons, heat, magnetic fields, and acoustic impulses; and material working using high-frequency capacitor discharges. 1006 references. (M.J.T.)

Accelerators

Refer also to abstracts 9913 and 9959.

9608 (ANL–7029, pp 13-14) INSTALLATION OF A 2-Mev VAN DE GRAAFF GENERATOR. Wallace, J. R.; Kaminsky, M. S. (Argonne National Lab., Ill.).

A surplus 2-Mev Van de Graaff generator was converted into a positive-ion accelerator. The accelerator and its uses are described. (M.O.W.)

9609 (BNL–9785) A DEVICE FOR RELIABLE MEASUREMENTS OF CURRENT IN A LOW ENERGY, HIGH INTENSITY ION BEAM. Wroe, Harold (Brookhaven National Lab., Upton, N. Y.). Nov. 22, 1965. Contract AT-30-2-GEN-16. 8p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

A device is described which combines a collector cup with a calibrated calorimeter so that thermal and electrical measurements can be carried simultaneously. The performance of the device for measuring the output current of the MkI duoplasmatron source is discussed. (M.O.W.)

9610 (JINR-P–2395) EKSPERIMENTANOE OPREDELENIE FAKTORA KACHESTVA IZLUCHENIYA VBLIZI USKORITELEI VYSOKOI ENERGII. (Experimental Determination of Quality Factor in the Vicinity of High Energy Accelerators). Lebedev, V. N.; Zeltchinskii, M.; Salatskaya, M. I. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1965. 10p. Dep. mn.

Experimental data are given which characterize the magnitude of the effective quality factor (QF) of the many-component pulsed radiation at different sections of the 10 Bev synchrophasotron. The measurements were made by the recombination method. The value of QF varies within 3–11. The results of measurements are compared with values determined at other high energy accelerators. Some values of QF are also given which were found from experiments with particle beams of 680 Mev synchrocyclotron. (auth)

9611 (NIRL/R/89) BEAM SENSING, RADIAL AND PHASE CONTROL SYSTEMS FOR NIMROD. Gardner, I. S. K.; Rees, G. H.; Sandels, E. G.; Soulby, G.; Swales, R. A. (National Inst. for Research in Nuclear Science, Chilton (England). Rutherford High Energy Lab.). Mar. 1965. 36p. Dep. mn. BIS $1.00. HMSO 5s.

The induction electrode systems that sense the radial and vertical motions of the proton beam are described, together with the radial and phase beam control systems used in the synchrotron. (D.C.W.)

9612 (NP–15790) KOGERENTNAYA NEUSTOICHIVOST PUCHKA V KAMERE S NEPROVODYASHCHIMI STENKAMI. (Coherent Instability of Beams Inside a Chamber With Nonconducting Walls). Mazepus, V. V.; Chirikov, B. V. (Akademiya Nauk SSSR, Novisibirsk. Institut Yadernoi Fiziki). 1965. 18p. Dep. mn.

The instability due to the coherent scattering of particles in the magnetic field induced by the beam in the walls of the accelerator chamber is investigated. The case of two parallel walls made of laminated iron is considered. (D.C.W.)

9613 (SGAE-G–3/1965) FOKUSSIERUNGSEIGENSCHAFTEN ELEKTRISCHER FELDER. (Focusing Characteristics of Electric Fields). Higatsberger, M. J. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf). [1965]. 19p. Dep.

A review is given of the focusing properties of electric fields using the examples of lens for pure electron optics and for lenses combined with magnetic fields in mass spectroscopy. The use of focusing electric fields in quadrupole or multipole fields, in ion drives in rocket systems, and in variants of particle accelerators are also considered in order to indicate the need for extensive research in these fields. (J.S.R.)

9614 ON THE SELF-CONSISTENT DISTRIBUTION OF PARTICLES AND THE MAXIMUM CURRENT IN LINEAR ACCELERATORS. Bondarev, B. I.; Vlasov, A. D. At. Energ. (USSR), 19: 423-8(Nov. 1965). (In Russian).

It is shown that the approximation of clusters accelerated uniformly by charged ellipsoids is roughly self-consistent. This fact again confirms the known expression based on it for the maximum current in a linear accelerator. It is also shown that the cylindrical approximation of clusters, not being self-consistent, nevertheless leads to an analogous expression for the maximum current, giving only some enlarged results. (tr-auth)

9615 OSCILLATION DECREMENTS IN ACCELERATORS IN THE PRESENCE OF ARBITRARY ENERGETIC LOSSES. Kolomenskii, A. A. At. Energ. (USSR), 19: 534-5(Dec. 1965). (In Russian).

Formulas are obtained for the decrements of betatron and synchrotron oscillations in the presence of arbitrary energy losses. These formulas, valid for all particle energies, permit the magnitude and sign of the internal drag associated with the losses and also the efficiency of methods for artificially damping the oscillations to be evaluated. Approximate expressions for the decrement are presented for the cases where (1) ionization losses produce a buildup of oscillations for $\beta < 1/\sqrt{2}$, (2) bremsstrahlung losses produce an oscillation buildup for $\beta < 1/2$, and (3) losses from magnetic relativistic bremsstrahlung lead to damping of the oscillations ($\beta = 1$), where $\beta = v/c$. (M.J.T.)

9616 FOCUSING COLD QUASINEUTRAL BEAMS IN ELECTROMAGNETIC FIELDS. Morozov, A. I. Dokl. Akad. Nauk SSSR, 163: 1363-6(Aug. 21, 1965). (In Russian).

The feasibility of charge compensated ion beam focusing is discussed analytically. Conditions are given which would insure the existence of an electric field to compensate the ion beam space charge. These conditions are: $kT_e/eU \ll 1$, $j/\sigma \ll E$, and $v_e \lesssim v_i$ which reduce the momentum equation for the cold electrons to the equation $E + 1/c\,[v_e,H] = 0$ which in turn insures the presence of an electric field perpendicular to both the electron drift velocity and the magnetic field. In particular, an annular geometry is selected to obtain a closed azimuthal electron drift. This leads to a magnetic field $\psi \equiv rA_\theta(r,z) = \text{const}$ and equipotential lines $\varphi = \varphi(\psi)$ which satisfy the requirement of space charge compensation for the ion beams. As a special case an external magnetic field is considered whose lines of force coincide with equipotential lines leading to the following condition for space charge neutralization $\varphi = E_\theta a \ln \rho/a$, $A_z = -H_\theta a \ln \rho/a$ and the following focusing plane is obtained for the ion beam $\theta = \pi/\sqrt{2 + (\omega_H/\theta)^2}$ (θ is the azimuthal angle). (ATD)

9617 RESONANCE TRAVERSAL IN WEAKLY NONLINEAR UNDAMPED OSCILLATING SYSTEMS. dePackh, D. C. (U. S. Naval Research Lab., Washington, D. C.). J. Nucl. Energy: Pt. C, 7: 539-46(Nov./Dec. 1965).

Many of the oscillations in particle accelerators and similar systems are characterized by weak nonlinearity, in which the wave does not depart materially from sinusoidal form, but in which the resonant frequency is amplitude-dependent. In such systems damping is often negligible, and it is so treated here. A distinction is made between cases of large and small initial amplitude, and approximate formulas are given to represent the probability of synchronous capture in these limits. Computer solutions of the amplitude increase and capture probability are given and compared with the limiting formulas. (auth)

9618 VACUUM CHAMBER WITH STABLE PERMEABILITY IN A HIGH-POWER ACCELERATOR. Galonsky, A. (Midwestern Univ. Research Ass., Stoughton, Wis.); Del Castillo, G.; Dyer, F. F. J. Nucl. Energy: Pt. C, 7: 584-7(Nov./Dec. 1965).

The permeability stability under irradiation of stainless steel type 205 for use as vacuum chamber material for high-energy accelerators was investigated. The method used was based on establishing a correspondence between the damage capabilities of reactor irradiation and high-energy accelerator radiation. The magnetic susceptibility of the reactor-irradiated and control samples were measured, and a permeability change was found to be much less than the tolerance of 0.005 specified for the MVRA accelerator. (L.B.S.)

9619 THE BUILDING AND SERVICES FOR THE HARWELL VARIABLE ENERGY CYCLOTRON. Harbert, G. M. (Atomic Energy Research Establishment, Harwell, Eng.). Nucl. Struct. Eng., 2: 464-74(Nov.-Dec. 1965).

The construction of the vault and target rooms of the Harwell Variable Energy Cyclotron is described. The mechanical, heating, cooling, ventilation and electrical services for the building are discussed. Particular reference is made to the power operated shielding doors and to the safety circuitry associated with them. (auth)

9620 PREPARATION AND INVESTIGATION OF TITANIUM–TRITIUM TARGETS. Fabian, Hans. Oesterr. Akad. Wiss., Math.-Naturwiss. Kl., Anz., 101: 248-76(1964). (In German).

The problems in the production of titanium foils and their impregnation with tritium are investigated. The results of the studies show that the properties of the target are not strongly reproducible but the fluctuations can be maintained generally in a relatively low range. The vapor deposition of the titanium foil is especially critical for the preparation of the target. It was established that the type of the storage of the foil between deposition and impregnation has no essential effect on the value of the target. Under certain conditions the maximum experimental yield is equal within ±20% of the calculated value. The accurate calculation of the maximum yield cannot be expected because of the inhomogeneous tritium in the foil. In the measurement of the maximum yield it is to be observed that this value can be obtained for only a short time because of the tritium loss of the target. It was established that two effects caused the important tritium loss. By the addition of a protection layer the loss effect can be extensively prevented and the lifetime of the target can be greatly lengthened. (J.S.R.)

9621 LOW ENERGY dc ION GUN. Clothiaux, Eugene J. (Duquesne Univ., Pittsburgh); Williams, H. Bartel; Lehman, Theodore H. Rev. Sci. Instrum., 37: 120-1(Jan. 1966).

The construction of an ion gun is described for producing a steady ion beam current of 1 to 10 mamp with a mean ion energy of 0.5 to 1.0 kev. (L.B.S.)

9622 THE IMAGE FORMATION PROPERTIES OF SHORT MAGNETIC DEFLECTION SYSTEMS FOR ATOMIC BEAMS WITH CONSIDERATION OF THE VELOCITY DISTRIBUTION. PART I. EVALUATION WITH NUMERICAL INTEGRATION. Becker, Gerhard; Fischer, Bernd (Physikalisch Technische Bundesanstalt, Brunswick). Z. Angew. Phys., 19: 537-42(1965). (In German).

The focusing efficiency of magnetic deflection systems on atoms with a negative effective moment and the defocusing efficiency on atoms with a positive effective magnetic moment were calculated, using numerical methods and with consideration of the modified Maxwell velocity distribution of the atoms of an atomic beam. The results are discussed in connection with applications in hydrogen masers. The intensity distribution of both types of atoms at the collector, the efficiency of the deflection system, the total efficiency of the beam deflection, the optimum velocity at the collector, the velocity distribution at the collector, and the dependence of the beam flux at the collector on the aperature ratio of the deflection system were also calculated. (tr-auth)

9623 PARTICLE ENERGY HOMOGENIZING DEVICE. Okubo, Makio (to Japan Atomic Energy Res. Inst.). Japanese Patent 1964-10449. June 12, 1964. Filed Aug. 2, 1962.

A particle energy homogenizing device is proposed that provides a large number of homogenized particles of a required energy for precise experiments. The primary and secondary particle beams produced in a high-frequency accelerator are deflected by deflecting magnets, and the particle energy is homogenized in an electric field produced in a cavity resonator to synchronize the particles to the high frequency used for the acceleration. (NSA of Japan)

9624 DEFLECTING SYSTEM FOR A CHARGED-PARTICLE BEAM. Hatano, Juichi (to Tokyo Shibaura Electric Co., Ltd.). Japanese Patent 1964-10450. June 12, 1964. Filed Dec. 26, 1962.

In a charged particle accelerator a number of deflecting devices are arranged along the acceleration path. Each deflecting device is connected with a high frequency generating device, and each is excited at a different frequency. Most of the particles are deflected from the direction of advance, while the remainder are left undeflected. With the proposed deflecting system, the electron, ion, or other charged-particle beam is made to have sufficiently large distances between consecutive masses for separation. (NSA of Japan)

9625 PARTICLE ACCELERATOR. Suematsu, Shigeru (to Hitachi, Ltd.). Japanese Patent 1964-12697. July 6, 1964. Filed Apr. 9, 1963.

A particle accelerator consists of an accelerating tube, insulating struts, electric sources, and ion sources. The parts have a protective cover of solid insulating material, such as polyethylene, methacrylic acid resin, etc. The outside surface of the cover is covered with a conducting layer connected to ground. The inner surface is lined at the places opposed to the ion sources, electron sources, etc. with a conducting layer serving as the high-voltage electrode; and the remainder of the inner surface corresponds to the accelerating electrodes. (NSA of Japan)

9626 LINEAR, CHARGED-PARTICLE ACCELERATOR. Kimura, Hiroshi (to Hitachi, Ltd.). Japanese Patent 1964-12698. July 6, 1964. Filed Mar. 8, 1963.

A charged-particle accelerator is designed to obtain a continuous high-energy charged-particle beam using the same length of accelerating tube as has previously been used for pulsed beam. In conventional accelerators when an electric current exceeding a certain value is used, the output energy is rapidly decreased; however, using the proposed method for electric currents exceeding the limited value, beams of high energy corresponding to that obtained with no current load in normal operation are obtained. In the method, the electron gun is pulsed a number of times for each microwave. The injected charged-particle current is modulated by a frequency approximately twice the period required for the electric field to be produced in the accelerating tube. (NSA of Japan)

9627 OUTPUT STABILIZING SYSTEM FOR THE LINEAR ACCELERATOR. Okada, Tsutomu (to Tokyo Shibaura Electric Co., Ltd.). Japanese Patent 1964-12699. July 6, 1964. Filed June 3, 1963.

A new system for stabilizing the output of a linear accelerator consists of a microwave generator for the acceleration, a device for detecting the variation in the microwave phase rate in the accelerating tube, and a device responsive to the detecting device for controlling the frequency of the microwaves from the generator. (NSA of Japan)

9628 ACCELERATING TUBE FOR A CIRCULAR PLATE TYPE LINEAR ACCELERATOR. Oshima, Atsutaro (to Tokyo Shibaura Electric Co., Ltd.). Japanese Patent 1964-18490. Aug. 31, 1964. Filed Aug. 16, 1962.

In an accelerating tube consisting of the tube and a number of circular-plate electrodes with holes at the center, the hole diameter of the circular plates, the thickness of the plates, and the spacing of the plates are increased or decreased irregularly along the axis of the accelerating tube. (NSA of Japan)

9629 CHARGED-PARTICLE ACCELERATOR. Kimura, Hiroshi (to Hitachi, Ltd.). Japanese Patent 1964-18493. Aug. 31, 1964. Filed Mar. 1, 1963.

A suitable number of electrodes are arranged along the path of a charged-particle beam, and a pulsed voltage is applied to each pair of electrodes consecutively, thus accelerating the charged-particle beam. The advantages obtained by the method are a uniform energy spectrum of the produced accelerated beam, relatively wide pulses from the pulse generator, and simple over-all design and construction. (NSA of Japan)

9630 APPARATUS FOR WORKING WITH AN ELECTRON BEAM. Katagiri, Shinjiro (to Hitachi Ltd.). Japanese Patent 1964-18695. July 2, 1964. Filed Mar. 12, 1962.

In the apparatus proposed, a means is provided for in-

jecting a gas onto the material to be worked to prevent oxidation or reduction. (NSA of Japan)

9631 PARTICLE ACCELERATOR. Adachi, Takeshi (to Tokyo Shibaura Electric Co., Ltd.). Japanese Patent 1964-19138. Sept. 7, 1964. Filed Oct. 5, 1963.

In the particle accelerator proposed, an improved insulation for the high voltage is obtained. The particle accelerator consists of a group of accelerating electrodes located in a cylindrical air-tight chamber of insulating material sealed at one end and in the intermediate part, a particle generator mounted outside the intermediate part, and connected to the accelerating electrodes, an electric source for energizing the particle generator, and an evacuating system connected to the air-tight chamber. (NSA of Japan)

9632 PARTICLE ACCELERATOR. Hatano, Juichi (to Tokyo Shibaura Electric Co., Ltd.). Japanese Patent 1964-19139. Sept. 7, 1964. Filed Nov. 9, 1963.

A highly corrosion-resistant accelerating tube, e.g., for a linear accelerator, is proposed. When the coolant water is circulated at higher velocity to obtain a uniform temperature distribution in the accelerating tube wall, the lifetime of the tube is prolonged by preventing corrosion by the liquid. This is achieved by plating, with a metal higher in corrosion resistance, the side of the copper accelerating tube in contact with the coolant water. (NSA of Japan)

9633 METHOD AND APPARATUS FOR ACCELERATION OF CHARGED PARTICLES USING A LOW VOLTAGE DIRECT CURRENT SUPPLIES. Serduke, James T. U. S. Patent 3,218,562. Nov. 16, 1965. Filed Aug. 20, 1962.

A method and apparatus are described for accelerating charged particles by injecting the particles into a direct current electric field across a gap and subjecting the particles to the accelerating effect of a difference of direct current potential across the gap. The difference of potential is supplied from two independent direct current sources. The apparatus is described in detail. (B.L.M.)

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Refer also to abstract 10073.

9634 (D1-82-0484) EFFECT OF THE INTERPLANETARY MAGNETIC FIELD ON SOLAR NEUTRON-DECAY PROTONS. Roelof, E. C. (Boeing Scientific Research Labs., Seattle, Wash. Geo-Astrophysics Lab.). Nov. 1965. 44p. (CONF-650961-7).

From American Geophysical Union 5th Western National Meeting, Dallas.

Upper bounds are placed on both steady-state and pulse (flare) outflow of neutrons above 1 Mev from the sun. The bounds are obtained by assuming that the neutron-decay protons diffuse in the interplanetary magnetic field in order to calculate the resultant proton fluxes from simple diffusion theory, and then comparing the theoretical fluxes with recent proton observations. Using the IMP-1 proton spectrum (20–75 Mev), it is shown that there could have been no significant contribution to the inner belt proton population in that energy range by steady neutron outflow in the first half of 1964, and perhaps as far back as 1961. For the same period and energy range, it is concluded that there could have been no higher steady outflow from the sun than $\sim 10^{22}$ neutrons sec^{-1} Mev^{-1}. As opposed to the meaningful upper bounds obtained for steady neutron outflow, it is found that neutron-decay protons are insensitive indicators of the presence of neutrons in solar flares. For instance, on the order of 10 percent of flare particles at energies 1 to 100 Mev could be neutrons, and yet their decay protons would cause only marginally observable modifications of the primary proton flux during the times of diffusion behavior at 1 AU. The same is true at 0.5 AU and 1.5 AU. (auth)

9635 ENERGY GENERATION IN A CONVECTIVE CORE. Gabriel, M.; Ledoux, P.; Denis, C. Ann. Astrophys., 28: 643-7(July-Aug. 1965). (In French).

In a convective core, the abundances of the long-lived nuclei entering a cycle of reactions do not reach local equilibrium values but adjust themselves in such a way that the mass average over the convective core of the rates of variations of the abundances vanish leading to an overall stationary state. The effect on the rate of energy production in the case of the carbon cycle is small of the order of 2 to 3%. The deviations from the local equilibrium abundances should also affect the vibrational stability of the star. (auth)

9636 DIELECTRONIC RECOMBINATION IN THE CORONA. Burgess, A. (London Univ.). Ann. Astrophys., 28: 774-8(July-Aug. 1965).

The full importance of dielectronic recombination in plasmas has only recently been realized. The process is discussed in detail for the case of low density plasmas, and formulas for the rate of the process are derived using correspondence principle and detailed balance arguments. Recent work in the derivation of a simple general formula for estimation of dielectronic recombination coefficients on the ionization balance for iron and calcium ions in the corona is reviewed. The new ionization balance curves are in much better agreement with observations on the Doppler widths of coronal lines. (auth)

9637 OBSERVATIONAL RESULTS OF X-RAY ASTRONOMY. Bowyer, S.; Byram, E. T.; Chubb, T. A.; Friedman, H. (Hulburt Center for Space Research, Washington, D. C.). Ann. Astrophys., 28: 791-803(July-Aug. 1965).

Results are reported of x-ray sources detected with an Aerobee rocket equipped with a counter about 10 times as sensitive as those used previously and covering a wavelength range 1 to 8 Å. Ten discrete sources of x rays could be identified from these observations. The distribution of sources is flattened toward the galactic plane. Tau XR-1 is an x-ray source within one arc min of the center of the Crab Nebula and of angular diameter of one arc min as determined from observation of a lunar occultation. The position of the strongest source, Sco XR-1, is known to about 0.5° and the remaining eight sources to about 1.5°. Three x-ray sources, Sco XR-1, Cyg XR-1, and Cyg XR-2, are not accompanied by any known optical or radio objects at their positions. Oph XR-1 matches the position of the Kepler SN 1604 and Sgr XR-1 is within 2.3° of Sgr A. The remaining five sources are not sufficiently well resolved or positioned to permit identifications with optical or radio sources. The x-ray flux from the Crab Nebula is compatible with synchrotron spectrum with index-1.1 and the flux of 1.8×10^{-8} erg/cm^2-sec (1.5-8 Å) fits the extrapolated optical synchrotron spectrum with the same index. The surveys completed thus far cover about 70% of the celestial sphere. All of the x-ray sources observed lie rather close to the galactic plane and within plus and minus 90° of the galactic center. This distribution resembles that of galactic novae and suggests that all of the x-ray sources thus far observed may be associated with supernova remnants in the galaxy. (BBB)

9638 RADIO RADIATION FROM THE GALACTIC NUCLEAR REGION. Burke, Bernard F. (Carnegie Inst. of Washington, D. C.). Ann. Rev. Astron. Astrophys., 3: 275-96(1965).

The principal astrophysical measurements that have been made by radio techniques fall into two categories, continuum studies and radio spectroscopy. The continuum radiation is studied by the determination of the radio noise intensity as a function of frequency and of position in the sky. The continuum observations are discussed in terms of the possible mechanisms of radio emission. A summary of the present state of radio spectroscopic observations is also given, with a discussion of recent observations of the OH radical. (TCO)

9639 SURGE PROMINENCES IN THE SOLAR ATMOSPHERE. Obashev, S. O. (Astrophysics Inst., Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 163: 599-602 (July 21, 1965).

A characteristic surge prominence observed with an AFR-2 telescope on 23 October 1957 is discussed. Se-

quential photographs show both the flare and the associated limb prominence. The rate of ascent and descent of the prominence was constant: $v = (h_2 - h_1)/(t_2 - t_1) =$ const. (respectively, 1.4×10^7 cm/sec and 1.2×10^7 cm/sec). The total number of hydrogen atoms N_H was calculated to be 1.5×10^{41} and its mass $N_H m_H$ 2.4×10^{17} g. The kinetic energy of the prominence was 10^{31} erg. The configuration of the magnetic field of groups of sunspots probably determines the type of energy conversion which takes place, i.e., the formation of a flare or a surge prominence. It is shown that the matter constituting a prominence cannot be "supplied" from the surrounding region; hence, prominences are formations occurring in the photosphere or the lower chromosphere, which adjoins the photosphere. (ATD)

9640 ROTATION OF SUPERDENSE CONFIGURATIONS. Gurovich, V. Ts.; Guseinov, O. Kh. JETP Lett. (USSR) (Engl. Transl.), 2: 70-2(Aug. 1, 1965).

The influence of rotation on the parameters of superdense stars is considered. The configuration parameters are estimated for a simplified model. The star rotation is assumed to be such that the deviation from sphericity of the hyperon core, which has 0.93 to 0.97 of the mass of the entire configuration, can be neglected. The angular momentum of the star should then be smaller than a certain value which is of the order of the solar momentum. Under this assumption the shell of the hyperon star rotates in fact in an external gravitational field produced by a spherically-symmetrical rotating core. This model is a relativistic generalization of Roche's known model in Newton's theory. (J.F.P.)

9641 ATTEMPT TO CONSTRUCT A SCHEME FOR THE MOST FREQUENTLY OCCURRING ISOTOPES IN THE UNIVERSE. Kandilarov, G. G. Monatsh. Chem., 96: 1105-16(1965). (In German).

The possibility of a relation between the atomic numbers, masses, and nuclear structures of the most common isotopes and their abundance is explored. The masses of the most common uneven isotopes differ by four or a multiple of four; except for ^{35}Cl these uneven isotopes stand near an even isotope more common than the uneven isotope. Uneven isotopes of greatest abundance are pure elements with an even number of neutrons, isotonic with the most common even isotopes; these isotonic pairs often occur together in nature. Two schemes for relating these facts are suggested. One arrangement for the most common elements according to atomic number shows the most common even elements in four vertical columns with relations between members of a column and related columns. The second scheme for the most common isotopes is similar to that for elements. The relation between these findings and the shell model of the nucleus is discussed. (BBB)

9642 STRUCTURE OF THE QUASI-STELLAR RADIO SOURCE 3C 273 B. Rees, M. J.; Sciama, D. W. (Cambridge Univ., Eng.). Nature, 208: 371-4(Oct. 23, 1965).

It is shown that the radio variations of 3C 273 B are consistent with its red shift being cosmological; and that the variable component of the optical continuum of 3C 273 B may be partly due to inverse Compton collisions between relativistic electrons and their own synchrotron radiation. (L.B.S.)

9643 MULTI-BARYONS AND MANY-BODY FORCES. Just, K. (Argonne National Lab., Ill. Univ. of Arizona, Tucson). Nuovo Cimento (10), 40A: 1100-9(Dec. 21, 1965).

In order to overcome the well-known gravitational instability of very massive stars at low temperature, it was postulated previously that high pressure favors particles with large masses, called multi-baryons. This is, however, suggested also by quantum theory because high densities favor the forces generated by the cyclic interchange of quanta among many particles. Although those many-body forces are insignificant at ordinary densities, their nonlinear superposition makes them so strongly growing with the density that the formation of multi-baryons seems quite natural. (auth)

9644 SPECTRUM OF CRAB NEBULA X RAYS TO 120 kev. Peterson, Laurence E.; Jacobson, Allan S.; Pelling, R. M. (Univ. of California, San Diego, La Jolla). Phys. Rev. Lett., 16: 142-4(Jan. 24, 1966).

The x-ray spectrum of the Crab nebula was measured over the energy range from 16 to 120 kev using a scintillation detector flown by balloon from Palestine, Texas, on Sept. 23, 1965. (D.C.W.)

9645 ANISOTROPIC DIFFUSION OF SOLAR COSMIC RAYS. Axford, W. I. (Cornell Univ., Ithaca, N. Y.). Planet. Space Sci., 13: 1301-9(Dec. 1965).

A simple model is described for solar cosmic-ray events which appears to be in reasonable accord with observations. The model is based partly on some earlier models, together with the assumption that the diffusion of particles is strongly anisotropic due to the presence of the interplanetary magnetic field. Some remarks concerning the limitations of the diffusion equation are included, and it is pointed out that the propagation of solar cosmic rays might be best described in terms of an analogy to electrical transmission lines rather than to the conduction of heat as is usually done. (auth)

9646 ASTROPHYSICAL NEUTRINOS. Ruderman, M. A. (New York Univ., New York). Rep. Progr. Phys., 28: 412-62(1965).

Three main aspects of neutrino astrophysics are surveyed: the use of neutrinos as a stellar probe; the exploration of neutrino properties by astrophysical observations; and the possibility and significance of cosmic neutrino fluxes. The anticipated early detection of solar neutrinos should accurately specify conditions at the center of the sun. Details of the solar neutrino flux and detection are summarized together with the expected fluxes from other astronomical and geological sources. Solar and geological observations are shown to give very restrictive limits on possible neutrino electromagnetic properties. Astrophysical evidence is considered which relates to the unproved hypothesis that there exists a direct weak coupling of neutrino–electron pairs. Particular emphasis is given to effects on stellar evolution rates as inferred from observed distributions within galactic clusters, and to solar and terrestrial iron peak abundances although these data are insufficient definitively to prove or exclude the pair interaction. Speculative neutrino roles involve supernovae, exotic sources, primeval and universal neutrino densities. Cosmological and experimental limits on cosmic neutrino fluxes are discussed together with prospects for their detection. (auth)

9647 X-RAY EMISSION OF THE SUN. Mandel'stam, S. L. (Lebedev Inst. of Physics, Moscow). Space Sci. Rev., 4: 587-665(Sept. 1965).

A review of experimental observations and theoretical calculations of solar x-ray emission is presented. 89 references. (D.C.W.)

9648 DYNAMICAL THEORY OF THE SOLAR WIND. Parker, E. N. (Univ. of Chicago). Space Sci. Rev., 4: 666-708(Sept. 1965).

The dynamical equilibrium theory of an atmosphere which has an extended temperature and which is strongly bound to the sun by gravity is summarized. 106 references. (D.C.W.)

9649 COMPOSITION OF SOLAR COSMIC RAYS. Biswas, S. (Tata Inst. of Fundamental Research, Bombay); Fichtel, C. E. Space Sci. Rev., 4: 709-36(Sept. 1965).

A review on the composition of particulate solar radiation is presented. Charge spectra, energy spectra, and the isotopic composition of the helium and hydrogen nuclei are discussed, together with the relation of these observations to the theories of solar particle acceleration and propagation. 98 references. (D.C.W.)

9650 THE Li ABUNDANCE AND THE ISOTOPIC RADIO $^6Li/^7Li$ IN SUNSPOTS. Schmahl, G.; Schroeter, E. H. (Univ. Sternwarte, Goettingen, Ger.). Z. Astrophys., 62: 143-53(1965). (In German).

The abundance of Li and the isotope ratio $^6Li/^7Li$ is redetermined using four sunspot spectra obtained by P. Stumpff (1961). From the measured equivalent widths of the resonance line λ 6708 (being approx. fifty times stronger

in sunspots as compared with the photosphere) a minimal value of the Li-abundance is derived. A small depression of the continuum—arising presumably from the Li line λ 6104—allows the calculation of an upper limit of the Li-abundance. Thus it follows: $(H/Li_{min}) = 2.3 \cdot 10^{11}$ and $(H/Li_{max}) = 10^{11}$. The observed mean profile of the medium strong line λ 6708 containing the resonance doublets of ^6Li and ^7Li is compared with calculated profiles assuming different ratios $^6Li/^7Li$. One obtains $^6Li/^7Li < 0.1$. However, using a more accurate value for the absorption coefficient in the line center of the strongest component λ 6707.761 the best fit is obtained for $^6Li/^7Li \approx 0.05$. (auth)

9651 STUDIES OF SELECTED SOLAR PHENOMENA [Thesis]. de Gaston, Alexis Neal. Provo, Utah, Brigham Young Univ., 1965. 165p.

An investigation into the possible existence of sympathetic flares is conducted using Lockheed Solar Observatory data consisting of photographs taken in H_α light at the rate of one frame every ten seconds. The data are analyzed for departure from random on a time basis, by considering the heliographic distribution of the flares, and by examining the velocity distribution of a selected set of flares. It is concluded that sympathetic flares probably do exist, but not at very large distances from one another. The driving mechanism of the differential rotation of the sun is hypothesized to be of a magnetohydrodynamic nature, which adds angular momentum to the equatorial region of the sun at the expense of the angular momentum in the polar regions. The coupling mechanism is the rigidity of the sun's general dipolar field with respect to the coronal plasma. The velocity of matter streaming from the polar regions is found to be 10^2 to 10^3 km/sec. The angular momentum transferred out by this mechanism is approximately 10^{36} erg-sec/yr or about 10^2 times the amount of angular momentum in the corona. The rate of transfer of angular momentum to the photosphere through the chromosphere is found to be at a rate sufficient to equal the total amount of angular momentum in the corona after a time period of approximately one day to one year, depending on the actual value of the viscosity coefficient. (Dissertation Abstr.)

9652 A THEORETICAL MODEL FOR THE EMISSION OF THE DECAMETRIC RADIATION FROM JUPITER [Thesis]. Gulkis, Samuel. Gainesville, Fla., Univ. of Florida, 1965. 217p.

The known characteristics of the Jovian decameter radio noise storms are reviewed. The more important of the numerous theories which have been proposed to explain the storms are discussed in detail. The results of polarization measurements made at Gainesville, Florida, and at Maipu, Chile, at 15.9 and 22.2 Mc/s are reported for the 1962 and 1963 apparition of Jupiter. These are compared with the results for previous years. It is suggested that many characteristics of the radio noise can be explained in terms of propagation effects due to the presence of field-aligned ducts of ionization in the Jovian magnetosphere. Various ray paths are computed for a model magnetosphere and are used to explain such observed phenomena as the frequency drift of noise storms, the polarization of individual pulses, and the narrow bandwidths of individual pulses. The effect of asymmetrical stop zones in the magnetosphere upon whistlers and also upon Doppler-shifted cyclotron radiation is investigated. It is proposed that the longitude variation of emission probability may be due to such asymmetry in the stop zones. (Dissertation Abstr.)

9653 SPECTRUM AND ORIGIN OF THE JOVIAN RADIO BURST STRUCTURE [Thesis]. Block, Wilbur Frank. Gainesville, Fla., Univ. of Florida, 1965. 117p.

The Jovian activity is classified as slow, normal, or fast, depending on the duration of the individual pulses constituting the fine structure of the bursts. Examples of the spectra of each of these three types of Jupiter activity are presented and discussed. Certain fringes appearing in the Jovian spectra are attributed to terrestrial ionospheric Faraday rotation and are utilized in calculating the frequency dependence of this Faraday rotation in the range 13 to 20 Mc/s. Tentatively, the result is that, in this region of the spectrum, Faraday rotation varies inversely as the 1.7 power of the frequency. Artificial satellite signals are used to study this same effect in the range 20 to 40 Mc/s. Here, in agreement with the quasi-longitudinal approximation, inverse square frequency dependence holds. The various spurious spectra that interfere with observations of Jovian spectra are described. Evidence supporting the existence of a radiation continuum emanating from Jupiter is presented. Jovian burst fine structure is compared to radio star and artificial satellite signal scintillations in terms of diurnal and seasonal variations, frequency, altitude, and geomagnetic activity. The basic Jovian pulse character is also examined utilizing Chree analyses of Zurich sunspot number, solar flare activity index, solar flare number, geomagnetic activity index, 2800 Mc/s solar flux density, and Jovian pulse character index. The dependence of the Jovian burst fine structure on System III longitude and the position of Jupiter's moon Io is shown. A comparison is drawn between the fine structure of the radio bursts from Jupiter and the scintillations in artificial satellite signals at near appulse. It is concluded that the basic pulse character of Jupiter's radio bursts arises in the Jovian environment and may reflect the turbulence of the solar particle flux. (Dissertation Abstr.)

Atomic Physics

Refer also to abstracts 9962, 9980, and 10077.

9654 (AD-465256) CHARGE-EXCHANGE COLLISIONS IN GASES. Compilation of Abstracts (Report No. 1 in this Series). Surveys of Soviet-Bloc Scientific and Technical Literature. (Aerospace Technology Div., Library of Congress, Washington, D. C.). May 25, 1965. 66p. (ATD-P-65-32).

References (122) are given to Russian journals published from 1930 to 1963. The references with abstracts are arranged alphabetically by author. A separate author index is included. (P.C.H.)

9655 (AERE-R-5090) THE RECOMBINATION BETWEEN CARBON MONOXIDE AND EXCITED OXYGEN ATOMS. Tait, J. H. (Atomic Energy Research Establishment, Harwell (England)). Nov. 1965. 14p. Dep.

The recombination cross section between electronically excited oxygen atoms and carbon monoxide was assessed. For the conditions in a reactor it is suggested that the physical process is the formation of an excited molecule which is stabilized on collision with another carbon dioxide molecule. An order of magnitude estimate was made of the cross section and was found to be .04 of the geometric for the gas pressure occurring in the Windscale AGR. (auth)

9656 (GA-6699) ELECTRONIC AND IONIC REACTIONS IN ATMOSPHERIC GASES. Yearly Technical Summary Report, September 1, 1964–August 31, 1965. Stebbings, R. F.; Fineman, M. A.; McGowan, J. W.; Turner, B. R. (General Atomic, San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science). Dec. 1, 1965. Contract DA-49-146-XZ-354. 130p. (DASA-1708).

Collisions involving charge transfer and charged rearrangement between some of the positive ions and neutral molecules present in the earth's upper atmosphere were investigated in a crossed beam experiment at energies within the range 2 to 200 ev. The charged reaction products are identified in a mass spectrometer, and absolute cross sections for their production are obtained. Interpolation between these values and those obtained at thermal energy in afterglow experiments provides information on the variation of the cross sections with energy in the intervening energy interval. The influence of excited ions is examined in some detail. Ionization of N_2 and H_2 just above threshold was investigated using monoenergetic electrons obtained with a 127-deg electrostatic energy selector. In both cases there was evidence of ionization occurring by autoionization as well as direct ionization. The agreement between the electron impact results and those obtained by photoioniza-

tion for the autoionization processes is compared. In the case of H_2, the structure in the second-derivative electron impact spectrum was interpreted to be due to the rotational states of H_2 and H_2^+ taking part in the ionization process. (auth)

9657 (IPPJ-42) MEASUREMENT OF THE EXCITATION FUNCTION OF N_2^+ FIRST NEGATIVE BANDS BY ELECTRON IMPACT. Hayakawa, Satio; Kumazaki, Tiaki; Nishimura, Hiroyuki; Otsuka, Masamoto (Institute of Plasma Physics, Univ. of Nagoya (Japan)). Sept. 1965. 18p. Dep. mn.

The intensities of lines belonging to the first negative bands of N_2^+ were measured as a function of the energy of bombarding electrons and the pressure of nitrogen gas. The comparison of the intensities of various lines around 4000 Å with and without an interference filter demonstrated that the filter transparent at 3940 ± 100 Å is good enough to select the 3914 line from others, provided that the gas pressure is lower than 10^{-3} torr. As the pressure increases, secondary electrons produced in the gas were found to contribute to the excitation. This can be accounted for in terms of the conventional theory of the secondary electron production and the energy dependence of the excitation cross section of the 3914 line. The latter was found to be approximately reproduced by an empirical formula proposed by Drawin. (auth)

9658 (IS-T-38) A NUCLEAR MAGNETIC RESONANCE STUDY OF ^{45}Sc HYPERFINE INTERACTIONS IN SCANDIUM-RICH Sc–Y, Sc–Zr, AND Sc–Gd ALLOYS [Thesis]. McCart, Bruce Ronald (Ames Lab., Iowa State Univ. of Science and Tech.). Nov. 1965. Contract W-7405-eng-82. 134p. Dep. mn; CFSTI $4.00 cy, $1.00 mn.

The nuclear magnetic resonance of ^{45}Sc was studied in a series of scandium-rich solid solution alloys in the Sc–Y, Sc–Zr, and Sc–Gd alloy systems. For each alloy studied, values were found for three hyperfine interaction parameters: the isotropic Knight shift, the anisotropic Knight shift, and the electric quadrupole coupling constant. The isotropic and anisotropic Knight shift results for the Sc–Y alloys indicate that the addition of yttrium causes a change in the electrons at the Fermi surface from s-character to d-character. The isotropic Knight shift decreases in proportion to the decrease in the density of electron states at the Fermi surface for the Sc–Zr-alloys. The anisotropic Knight shift changes in an anomalous manner which is unexplained as yet for the alloys in the Sc–Zr system. The isotropic Knight shift of the ^{45}Sc nmr line decreases with the addition of gadolinium. The anisotropic Knight shift appears to increase rapidly in magnitude in the Sc–Gd alloys. It was concluded that the electric field gradient of the conduction electrons and that of the ion lattice have the same sign. (P.C.H.)

9659 SYMMETRY OF THE HYDROGEN ATOM. Malkin, I. A.; Man'ko, V. I. (Moscow Physico-Technical Inst.). JETP Lett. (USSR) (Engl. Transl.), 2: 146-8 (Sept. 1, 1965).

It is shown that the symmetry group of the hydrogen atom is the noncompact group O_6, the Lie algebra of which is the algebra D_3, and a simple construction is presented showing that the functions belonging to the discrete spectrum form a single infinite-dimensional irreducible representation of this algebra. (J.F.P.)

9660 IONIZATION AND SCATTERING WITH CHARACTERISTIC ENERGY LOSSES IN ATOMIC COLLISIONS. Afrosimov, V. V.; Gordeev, Yu. S.; Panov, M. N.; Fedorenko, N. V. (Ioffe Physico-Technical Inst., Academy of Sciences, USSR). JETP Lett. (USSR) (Engl. Transl.), 2: 185-7(Sept. 15, 1965).

Collisions between argon ions and atoms, having kev energies at impact parameters smaller than the atomic dimensions, were previously studied. Analysis of the inelastic energy losses in the collision has shown that in addition to energy lost to ionization of the colliding particles, an excess inelastic energy loss, consisting of the kinetic energy of the removed electrons and of the radiation energy, is also observed. It was found that the spectrum of the excess inelastic loss is not continuous, but consists of relatively narrow discrete lines. To determine the extent to which the observed phenomenon is general, collisions between ions and atoms of different noble gases were investigated. Various properties of these collisions are shown and described. (J.F.P.)

9661 TOTAL CROSS SECTIONS OF ATOMIC EXCITATION BY ELECTRON IMPACT IN CLASSICAL APPROXIMATION. Veldre, V.; Lyash, A.; Rabik, L.; Fridkin, L. (Inst. of Physics, Academy of Sciences, Latvian SSR). Latv. PSR Zinat. Akad. Vestis, Fiz. Tek. Zinat. Ser., No. 4, 3-12(1965). (In Russian).

The problem of the atomic excitation of neon, argon, xenon, krypton, oxygen and nitrogen by electron impact was studied. The total cross sections were evaluated in classical approximation. The calculations were done on a computer. The results obtained are plotted and tabulated. (auth)

9662 INVESTIGATION OF THE WIDTH OF HELIUM SPECTRAL LINES WITH ELECTRON EXCITATION IN AN ATOMIC BEAM. Korolyov, F. A.; Odintsov, V. I. Opt. Spectros. (USSR)(Engl. Transl.), 18: 547-50(June 1965).

Translated from Opt. Spektros., 18: 968-73(June 1965).

The widths of certain singlet helium lines emitted by an atomic beam were studied. A large Doppler line width, due to collision of the atoms with the exciting electrons, was observed. A theoretical calculation of this width was carried out. The natural width of the $2\,^1P_1$ level and the related transition probability for the 584 Å resonance line of helium were determined. An estimate of the magnitude of the hyperfine structure of the singlet ^3He levels is given. (auth)

9663 RELATIVISTIC RADIATION TRANSITIONS. Babushkin, F. A. Opt. Spectros. (USSR)(Engl. Transl.), 19: 1-2(July 1965).

Translated from Opt. Spektros., 19: 3-5(July 1965).

A general mathematical expression is obtained for the probability of electric multipole relativistic radiation transitions. It is used to calculate the relative intensities of electric dipole transitions in the K series of characteristic heavy element x radiation. The calculated values were found to be in full agreement with the experimental data of Beckman. (auth)

9664 THEORETICAL STUDIES OF PHENOMENA ASSOCIATED WITH LEVEL CROSSING IN ^{23}Na AND ^{85}Rb. Kapelevskii, Yu.; Rosinskii, K. (Univ. of Warsaw). Opt. Spectros. (USSR)(Engl. Transl.), 19: 70-1(July 1965).

Translated from Opt. Spektros., 19: 135-6(July 1965).

The results of a theoretical determination of the quantities characterizing the crossing of the Zeeman levels of the hyperfine structure in the $3^2P_{\frac{1}{2}}$ state of sodium and $5^2P_{\frac{1}{2}}$ state of rubidium are presented. The strengths of the magnetic fields for which level crossing arises, the widths of the corresponding maxima, and the intensity of the interference phenomena were calculated. The halfwidth, intensity (ratio of interference maximum correction to the constant term), and anisotropy of the effect were determined for the case studied, that of unpolarized light. The results are given, which were obtained for unpolarized light and optimal geometry (the incident light beam, the fluoresence, and the direction of the magnetic field were mutually perpendicular). (J.F.P.)

9665 SPECTRA OF MULTIPLY IONIZED KRYPTON ATOMS. Kononov, E. Ya.; Mandelshtam, S. L. Opt. Spectros. (USSR)(Engl. Transl.), 19: 78-9(July 1965).

Translated from Opt. Spektros., 19: 145-6(July 1965).

The spectra of high multiplicity ions are studied in a plasma heated by rapid magnetic compression in order to attain high electron temperatures with high electron concentrations. The spectrum of krypton was obtained in the 65 to 110 Å range. The spectrum of this element clearly exhibits groups of these lines having as their analogs the corresponding line groups in the spectra of rubidium, strontium, and yttrium. The close similarity of the spectra of krypton and rubidium suggests that the groups of

Kr lines belong to the KrX-KrXIII ions and are due to transitions of the same type. It is noted that a considerable intensity of lines in the Kr spectrum lies in the region where the reflectance of the grating of the spectrograph is not very high. This might indicate that the process of formation of multiple ions is a highly efficient one. (J.F.P.)

9666 RELATIVE INTENSITIES OF PROMINENT LMM AUGER TRANSITIONS IN KRYPTON. Krause, M. O. (Oak Ridge National Lab., Tenn.). Phys. Lett., 19: 14-15 (Sept. 15, 1965). (ORNL-P-1515).

The LMM Auger spectrum of krypton was measured, and the relative intensities of the prominent Auger electron groups were determined. An analysis of the spectrum showed that 2p3d3d, 2p3p3d, and 2p3p3p transitions are predominant. (D.C.W.)

9667 OBSERVATION OF ELECTRIC-QUADRUPOLE HYPERFINE SPLITTING OF K X-RAYS FROM MUONIC ATOMS OF GOLD. Cote, R. E. (Argonne National Lab., Ill.); Guso, R.; Raboy, S.; Carrigan, R. A. Jr.; Gaigalas, A.; Sutton, R. B.; Trail, C. C. Phys. Lett., 19: 18-20 (Sept. 15, 1965).

The spectrum of the K x rays of muonic gold was measured and the splitting of the $2p_{\frac{3}{2}} \rightarrow 1s_{\frac{1}{2}}$ transition due to the interaction of the muon with the ground-state electric quadrupole moment of the gold nucleus was observed. (G.O.Y.)

9668 ON THE ENERGY LOSS OF HEAVY IONS. Bethge, K.; Sandner, P. (Univ., Heidelberg). Phys. Lett., 19: 241-3(Oct. 15, 1965). (In German).

As it is possible to determine the energy from the elastic scattering, the back scattering of B and N ions on thick targets of Ag, Ni, and Au was measured. The formula used for the evaluation of the differential energy loss was given. The measurements were made in the energy range from 0.5 to 2 Mev/amu. The results of the measurement are graphed in comparison with the theoretical pattern of the energy loss. The measurements show good agreement with theory. (J.S.R.)

9669 ELECTRON SPECTROSCOPIC DETERMINATION OF ELECTRON BINDING ENERGIES IN PLUTONIUM. Fahlman, A. (Uppsala Univ.); Hamrin, K.; Nordberg, R.; Nordling, C.; Siegbahn, K.; Holm, L. W. Phys. Lett., 19: 643-5(Jan. 1, 1966).

The electron spectroscopic method is extended to the transuranic region, and binding energies of the atomic electrons in the M and N shells of plutonium are measured. Microgram quantities of the element under study are used. (auth)

9670 EXPERIMENTAL SEARCH FOR CHARGE CONJUGATION NONCONSERVATION IN $^1S_0$ STATE POSITRONIUM DECAY. Liu, D. C.; Roberts. W, W. K. (Lewis Research Center, Cleveland). Phys. Rev. Lett., 16: 67-9(Jan. 10, 1966).

An experimental search was made for charge conjugation nonconservation in the decay of the $^1S_0$ state of positronium in aluminum and liquid oxygen. It was concluded that C nonconservation, if any, is independent of the radial quantum state. (G.O.Y.)

9671 THE CROSS SECTIONS FOR IONIZATION OF THE EXCITED STATES OF ATOMIC HYDROGEN BY HIGH ENERGY ELECTRONS. Kingston, A. E. (Queen's Univ., Belfast). Proc. Phys. Soc. (London), 86: 1279-81(Dec. 1965).

At large incident electron energies E the cross sections for ionization of the excited states of hydrogen may be written as A(log E)/E. The Bethe approximation was used to calculate the A's for all of the degenerate levels of the first five states of hydrogen. The calculations suggest that for the average ionization cross section of these states the A's are proportional to the $-\frac{1}{2}$ power of the ionization potential of the state. (auth)

9672 EQUILIBRIUM CHARGE-STATE FRACTIONS OF 0.2 TO 6.5 Mev HELIUM IONS IN CARBON. Armstrong, J. C.; Mullendore, J. V.; Harris, W. R.; Marion, J. B. (Univ. of Maryland, College Park). Proc. Phys. Soc. (London), 86: 1283-95(Dec. 1965). (TID-22011).

The fractions of He^0, He^+, and He^{2+} present in helium beams scattered at 0° through thin carbon foils were measured. Singly and doubly ionized beams of both ^3He and ^4He were used to obtain velocities corresponding to alpha particle energies from 0.2 to 6.5 Mev. The scattered ions were magnetically analyzed and the three charge states were simultaneously counted in three CsI crystals. Analysis of the data reveals that the ratio of electron-capture to electron-loss cross sections varies inversely with the fourth power of the ion velocity. It is suggested that this dependence is independent of equilibrating material and that the electron-capture and electron-loss cross sections vary inversely with the sixth and second power of the ion velocity respectively. Measurements made with foils of aluminum, nickel, silver and gold gave results similar to those obtained with carbon foils but, because of the uncertainty in surface contaminant effects, no definite conclusion could be drawn from these observations. (auth)

9673 THE IONIZATION OF INERT GAS ATOMS BY ELECTRON AND PROTON IMPACT AT HIGH ENERGIES. Kingston, A. E. (Queen's Univ., Belfast); Schram, B. L.; de Heer, F. J. Proc. Phys. Soc. (London), 86: 1374-6 (Dec. 1965).

At large energies E the electron ionization cross section Q of an inert gas atom may be written as QE = A log E + B. Renewed analysis of Schram's ionization measurements leads to the conclusion that there is good agreement between Kingston's calculated A values and the experimental A values. (auth)

9674 ELECTRON IMPACT IONIZATION CROSS-SECTION DATA FOR ATOMS, ATOMIC IONS, AND DIATOMIC MOLECULES: I. EXPERIMENTAL DATA. Kieffer, L. J.; Dunn, Gordon H. (Joint Inst. for Lab. Astrophysics, Boulder, Colo.). Rev. Mod. Phys., 38: 1-34 (Jan. 1966).

A compilation and critical evaluation of absolute cross sections for ionization of atoms and diatomic molecules by electron impact is given. Experimental techniques used for ionization are surveyed. Selected relative cross sections for production of multiply charged ions and a brief discussion of relative cross-section data near threshold are presented. Absolute limits are not set on the size of probable systematic errors in the various experiments. (auth)

9675 EMISSION OF ELECTRONS ON BOMBARDMENT OF ALKALI HALIDE SINGLE CRYSTALS WITH SLOW HELIUM AND ARGON IONS. Kondrashev, A. I.; Petrov, N. N. (Kalinin Polytechnic Inst., Leningrad). Soviet Phys.-Solid State (Engl. Transl.), 7: 1255-6(Nov. 1965).

Translated from Fiz. Tverd. Tela, 7: 1559-60(May 1965).

The secondary emission produced by the bombardment of single-crystal plates of lithium fluoride, sodium chloride, potassium bromide, and cesium iodide by helium and argon ions with energies from 20 to 600 ev is investigated. The results obtained for each of the samples are shown. In these curves, the ratio of the saturation current in the target to the primary ion current is plotted against the bombarding energy. These results are discussed. (J.F.P.)

9676 SOME PECULIARITIES OF THE FOCUSING OF ATOMIC COLLISIONS IN CATHODE SPUTTERING FROM TUNGSTEN AND MOLYBDENUM SINGLE CRYSTALS. Ashmyanskii, R. A.; Ben'yaminovich, M. B.; Veksler, V. I. (Tashkent State Univ.). Soviet Phys.-Solid State (Engl. Transl.), 7: 1314-19(Dec. 1965).

Translated from Fiz. Tverd. Tela, 7: 1623-9(June 1965).

The energy and angular distributions of the sputtered atom current ejected from single crystals of tungsten and molybdenum by mercury ions were investigated. It was shown that in the ⟨111⟩ directions there is good focusing for slow particles and in the ⟨100⟩ directions for fast particles. With increasing initial ion energy, the par-

ticle flow in the ⟨100⟩ directions increased relative to the flow in the ⟨111⟩ directions. (auth)

9677 ON THE TEMPERATURE DEPENDENCE OF THE CROSS SECTION FOR INELASTIC SCATTERING. Zeppenfeld, K. (Universitaet, Hamburg). Z. Naturforsch., 20a: 1076(Aug. 1965). (In German).

The temperature dependence of the inelastic scattering and especially that of the volume plasma loss and its vicinity was determined. The 13-ev loss in Pb at two different temperatures were shown. The surface ratio of the loss maximum to the elastic maximum is equal to the quotient of the layer thickness and the mean free path for the inelastic scattering processes occurring. This path is temperature-dependent in Pb. The same results were found for Si and Al. (J.S.R.)

9678 MEASUREMENT OF TOTAL CROSS SECTIONS FOR THE SCATTERING OF LOW ENERGY ELECTRONS BY ARGON AND MOLECULAR OXYGEN AND NITROGEN [Thesis]. Aberth, William Henry. New York, New York Univ., 1963. 98p.

An atom beam recoil technique was used to measure absolute total electron scattering cross sections for argon and molecular oxygen and nitrogen in the energy range of 1 to 25 ev. The atom beam is cross-fired by an electron beam and the resultant attenuation of the atom beam is measured. Since both the total beam and the scattered component of the beam are measured by the same detection and amplification system, it is possible to determine absolute cross sections without requiring knowledge of the beam detection efficiency or the overall gain of the amplification system. The atom beam was detected by means of a beam-ionizing electron gun. A narrow band phase sensitive amplifier, coupled with an integrator, recorded the final signal. Integration times of 10 to 30 minutes enabled attenuations of less than one ten thousandth of the full beam to be detected. The cross sections measured appear to be somewhat larger than those of Brüche and Normand, but agree well qualitatively. (Dissertation Abstr.)

9679 SECONDARY ELECTRON PRODUCTION FROM ALPHA PARTICLES AND FISSION FRAGMENTS [Thesis]. Anno, James Nelson Jr. Columbus, Ohio, Ohio State Univ., 1965. 87p.

The secondary electron yield was measured for alpha particles emerging from a thin gold surface layer and for fission fragments emerging from thin films of uranium dioxide. Simple current measurements between an electrode emitting the charged particles (and accompanying secondary electrons) and a biased grid were used to determine the secondary electron yields. The secondary electron yield due to polonium-210 alpha particles emerging from a 0.00010-in.-thick surface layer of gold was determined to be 9.21 ± 0.75 for an average alpha-particle charge of 1.86. The corresponding ratio of charge carried by the secondary electrons emitted from the gold surface to the charge carried by the emerging alpha particles was determined to be 4.95 ± 0.16. This ratio is free from assumptions on the average charge of an alpha particle. These results are consistent with yield observations with other singly or doubly charged high-energy particles. The secondary electron yield from fission fragments leaving thin films of uranium dioxide was found to vary from 572 ± 58 to 299 ± 45 electrons per fragment over a film thickness of 0.1 to 3 microns. The ratio of charge carried by the secondary electrons emitted from the surface to the charge carried by fission fragments was also determined. With film thickness, this ratio varies weakly from 28 for a 0.1-micron coating to about 21 for a 3-micron coating. The behavior of the charge ratio and secondary electron yield with coating thickness is in qualitative agreement with theory. The ratio of the yield due to fission fragments at normal incidence coming from the UO_2 coatings to the yield due to alpha particles at normal incidence coming from gold was found to be about 20, substantiating the assumption that the secondary yield is proportional to the mass stopping power of the target material. A weak dependency of the yield on electric field was observed. (Dissertation Abstr.)

9680 THE KL_I TRANSITION IN HIGH Z ELEMENTS [Thesis]. Woldseth, Rolf. St. Louis, Washington Univ., 1965. 129p.

Certain aspects of possible parity violation in electromagnetic interactions were investigated. The possible existence of a static electric dipole moment of the electron (EDM) is allowed. The KL_I transition is in the normal theory permitted only as a magnetic dipole (M 1) transition. The transition probabilities were computed for two possible channels of the KL_I transition (i.e., M 1 and EDM mixing) for a number of high Z elements in the region Z = 73 to Z = 92, using relativistic hydrogenic wave functions. These form the basis for establishing an upper limit on the size of a possible EDM from the experimental values of the KL_I intensities. A flat single crystal spectrometer was used to make a specific search for the KL_I line in a series of high Z elements (Ta, W, Pt, Au, Hg, Pb, and Bi), and positive evidence of the line was found in Ta, W, Pt, Au, and Hg. All the experimentally determined values are within or below the range of the theoretical M 1 intensities, which might be accounted for in the normal theory by invoking the Auger effect. No positive evidence can be seen that would indicate any EDM mixing enhancement. An upper limit to the possible size of an EDM may be established in two ways. One may assign the total of the measured intensity to the EDM channel, which based on the values for mercury gives EDM < 10^{-2} eħ/mc. Based on the fact that the measured value for tantalum is larger than the theoretical M 1 value, one may assign this excess to the EDM channel, giving for tantalum EDM < $7 \cdot 10^{-3}$ eħ/mc. The KL_{II}/KL_{III} intensity ratio was measured for some elements, giving in general slightly higher values than those found in the literature. The general result is to confirm that the retardation effect dominates over the relativistic effect in determining the deviation from the 1 : 2 statistical ratio, as is indicated by the theory. (Dissertation Abstr.)

9681 HIGHER PARTIAL WAVES IN POSITRON HYDROGEN ELASTIC SCATTERING [Thesis]. Kleinman, Chemia Jacob. New York, New York Univ., 1965. 125p.

The improved minimum principle (MP) for single-channel scattering is applied to obtain lower bounds on the p-wave and d-wave phase shift, η_L, for the elastic scattering of positrons by atomic hydrogen. The method requires the exact numerical solution of the static equation and of the corresponding Green's function, and also the orthogonalization of the trial function, $Q\Psi_t$, to the open channel wave function. The trial function is chosen to be of the exponential-polynomial form. Rigorous lower bounds, η_L(MP), are obtained on the exact phase shifts. The bounds include contributions from the hydrogenic states with angular momenta l_1 = 0, 1, 2, and 3 for a total orbital angular momentum L = 1, and l_1 = 0, 1, and 2 for L = 2. The bounds are compared with previous estimates. The effects of the l_1 states on η_L(MP) not explicitly included in $Q\Psi_t$ and the errors in $Q\Psi_t$ are estimated. For L ≥ 1, the effect on η_L(MP) of the virtual excitation to the l_1 = 1 state dominates. Knowing the phase shifts and the partial cross sections for L = 0, 1, and 2, it is possible to estimate reliably the differential and total cross sections over most of the energy domain for which only elastic scattering is possible. It is possible to check the efficacy of the MP approach for the present problem in a given approximation and at the same time obtain a partial check on the code as a whole by comparing these results with the close-coupling results involving virtual excitation of the 2p and 3d states of the target. As expected, the values for η_L(MP) are consistently either equal to or lower than but generally quite close to the exact values obtained by numerical solution. The applicability of the effective range formula for the scattering of charged particles by polarizable systems, which was derived earlier from the long range potential effect, is studied near zero scattering energy. A theoretical study is made of the ratio of virtual excitations, i.e., the ratio of the contribution to the quantity calculated with the MP from the several orbital angular momenta of the incident particle, l_2, involved with a given $l_1 > 0$ and L = 1 and L = 2. (Dissertation Abstr.)

9682 NONADIABATIC THEORY OF INELASTIC ELECTRON-HYDROGEN SCATTERING [Thesis]. Kyle, Herbert Lee. Chapel Hill, N. C., Univ. of North Carolina, 1964. 77p.

The nonadiabatic theory is applied to the inelastic S-wave scattering of low-energy electrons from atomic hydrogen. The zeroth order (angle-independent) approximation for excitation of the 2s level from the ground state is described by the same equation used to describe elastic scattering below the 2s threshold, but with more complicated boundary conditions. The solution was effected by expanding the wave function in terms of separable solutions. With the assumption of reciprocity it is also possible to obtain the 2s-2s cross sections. The elastic (1s-1s) cross sections are within one percent of the close coupling results in the triplet case, but are about 20 percent greater in the singlet case. The inelastic (1s-2s) cross sections are reduced about 20 percent in the triplet case and 20 percent to 40 percent in the singlet case relative to the close coupling results. (Dissertation Abstr.)

9683 RESONANCE BROADENING OF SPECTRAL LINES [Thesis]. Ali, Abdul-Wahab Kadir. College Park, Md., Univ. of Maryland, 1965. 71p.

The resonance broadening of Lyman-α was calculated using the impact broadening theories of Baranger, Griem, and Kolb. The interaction potential between the radiator (a hydrogen atom in the first excited state) and the perturber (another hydrogen atom in the ground state) is taken as the dipole-dipole interaction in a first approximation. Higher order interactions, namely the dipole-quadrupole, and the quadrupole-quadrupole interactions, were also considered. However, it is shown that the last two interactions do not contribute significantly to the width. The solution of the appropriate time-dependent Schrödinger equation is obtained by iteration with a precision of 2% in the width. No significant shifts are predicted. A general formula is given for the resonance width for other lines in terms of absorption oscillator strengths and statistical weights. This may be used to obtain f-values from a measurement of the line width, knowing the atom densities. (Dissertation Abstr.)

9684 μ^--CAPTURE BY ^{3}He [Thesis]. Yano, Alva Fumihiko. Rochester, N. Y., Univ. of Rochester, 1965. 133p.

Results of calculations for the capture rates in the following reactions are presented: (a) $\mu^- + {}^3\text{He} \rightarrow {}^3\text{H} + \nu$, (b) $\mu^- + {}^3\text{He} \rightarrow \text{n} + \text{d} + \nu$, and (c) $\mu^- + {}^3\text{He} \rightarrow \text{n} + \text{n} + \text{p} + \nu$. The calculations are based on the Primakoff theory and include the "relativistic" terms of his effective Hamiltonian. It is assumed that the trion (generic term for ^{3}He, ^{3}H isotopic doublet) wave function is described by the configuration $(s)^3$. The capture rate of reaction (a) depends sensitively on the effective r.m.s. radius of the trion. Therefore the calculation of reaction (a) was performed in terms of the hard core parameter d, which controls the r.m.s. radius. The rate for reaction (b) is calculated in the "no-polarization" approximation for the n + d final state wave function. The final state interaction is included by means of phase shifts obtained from analysis of n-d scattering experiments. A direct calculation for the rate of reaction (c) is not attempted since the three-nucleon final state interaction makes such a calculation extremely complicated. The problem was attacked by means of a set of partial closure calculations. These calculations are associated with the different symmetry classes of the three nucleons in the final state. Finally, the calculations were compared with the available experimental data. (Dissertation Abstr.)

9685 INELASTIC COLLISIONS OF N_2^+ AND H_2^+ IONS WITH HYDROGEN MOLECULES [Thesis]. Vance, Dennis William. Gainesville, Fla., Univ. of Florida, 1965. 88p.

Measurements were made of several inelastic ionic collision processes occurring in collisions of N_2^+ and H_2^+ ions with hydrogen molecules. The experimental procedure consists of an energy analysis of the charged products of the ionic collisions followed by magnetic deflection mass analysis of these products for positive identification. In cases where the energy ranges of the products are well separated from one another, the cross sections for the reactions may be obtained without knowledge of the transmission of the product analyzing system. Five distinct inelastic processes were observed and identified. These processes are non-resonant charge transfer and dissociative charge transfer in the $N_2^+ - H_2$ system, and resonant charge transfer, collision induced dissociation, and ion-molecule reaction in the $H_2^+ - H_2$ system. Cross sections for these processes were determined over the range of incident ion energy from 5 to 100 ev, as measured in the laboratory system. The cross sections in the $N_2^+ - H_2$ system are very large, the total observed inelastic cross section attaining a value of about 30 Å^2 at 100 ev. The cross sections in the $H_2^+ - H_2$ system are smaller, and are in fair agreement with those expected on theoretical grounds. In cases where comparisons with existing results are possible, the present results agree quite well with previous work. The results in the case of reactions involving three products indicate that the mechanism of these collisions is quite complex and cannot be adequately explained by the usual simple models that apply at higher energies. (Dissertation Abstr.)

Cosmic Radiation

See also Elementary Particles and Radiations
Nuclear Properties and Reactions

9686 (IAE–876) AZIMUTAL'NYE UGLOVYE RASPREDELENIYA VTORICHIYKH CHASTITS V KOSMICHESKIKH LIVNYAKH. (Azimuthal Angular Distribution of Secondary Particles in Cosmic Showers). Mishakova, A. P.; Nikol'skii, B. A. (Institut Atomnoi Energii, Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow). 1965. 20p. Dep. mn.

The azimuthal angular distributions of secondary particles in 169 showers with energies from 10^{10} to 10^{14} ev are studied by the method of paired angular correlations. An isotropic azimuthal angular distribution is observed for the primary showers giving rise to nucleons, and an anisotropic distribution for secondary showers giving rise to pions; this difference points to a different mechanism for the N-N and π-N interactions. Data on the angular correlation of secondary shower particles are explained from the point of view of the fireball model. (tr-auth)

9687 SEARCH FOR COSMIC-RAY CHARGED PARTICLES HAVING MASS $\geq 50\ m_e$ AND DECAYING IN MILLISECOND TIME INTERVALS. Astiani, T. L.; Nazaryan, A. A.; Sharkhatunyan, R. O. JETP Lett. (USSR) (Engl. Transl.), 2: 72-4(Aug. 1, 1965).

To check on the existence of unstable cosmic ray charged particles with lifetimes in the millisecond interval, an experimental setup was constructed, which is shown. This setup permitted highly reliable visual identification of decay events in space, and by the same token, eliminated false events due to random coincidences. The design and performance of this experimental arrangement are described. Measurements were made at 960 meters above sea level under a layer of ground corresponding to a meson (μ) energy of 2 Bev. The experiment shows that the intensity of the charged particles with lifetimes of 10^{-4} to 10^{-1} seconds is less than 4.5 $(10)^{-3}$% of the meson (μ) intensity. This result holds true if these particles, like mesons (μ) are nuclearactive. (J.F.P.)

9688 PRELIMINARY RESULTS OF MEASUREMENTS OF THE INTENSITY OF DISTRIBUTED COSMIC RADIO EMISSION BY THE ELEKTRON-2 SATELLITE. Benediktov, E. A.; Getmantsev, G. G.; Sazonov, Yu. A.; Tarasov, A. F. Kosm. Issled., 3: 614-17(July-Aug. 1965). (In Russian).

Preliminary results of measurements of the intensity of distributed cosmic ratio emission conducted by Elektron-2 are presented. A 4-m rod antenna connected with two receivers was used in the measurements. The receivers

operated at fixed frequencies of 725 and 1525 kc. Passbands were 3.9 kc at 725 kc and 7.4 kc at 1525 kc. Time constant of the output circuit was 1 sec. Some readings taken at the apogee (68,000 km) showed changes in cosmic radio emission levels with time; these were attributed to the spin of the satellite. Absolute values of the effective temperatures of the sky at 725 and 1525 kc were 3.2×10^7K and 1.2×10^7K, respectively. An increase in absolute effective temperature was noted with decreased frequency, and, conversely, radio emission intensity dropped with decreased frequency. Maximum emission was observed at latitudes of ±40° to 50°. The intensity of distributed cosmic radio emission at 725 kc was 0.51×10^{-20} w m^{-2} cps^{-1} $sterad^{-1}$ and at 1525 kc, 0.87×10^{-20} w m^{-2} cps^{-1} $sterad^{-1}$. (ATD)

9689 DAILY VARIATION OF COSMIC RAYS. Mercer, J. B.; Wilson, B. G. (Univ. of Alberta, Calgary). Nature, 208: 477-9(Oct. 30, 1965).

An alternative mechanism is proposed for the removal of particles from the morning side of the earth in the daily variation of cosmic rays, other than scattering by magnetic irregularities. This mechanism is that of solar absorption due to magnetic mirror configurations between the earth and the sun and also that of cosmic ray gas streaming past the earth due to corotation of the gas with the sun. The resultant is the vector sum of the two effects. Various restrictions on this mechanism are listed. (J.F.P.)

9690 ANTIMATTER AND TREE RINGS. Venkatavaradan, V. S. (Tata Inst. of Fundamental Research, Bombay). Nature, 208: 772(Nov. 20, 1965).

The probability that the energy released in the Tunguska meteorite impact came from antimatter annihilation is examined. When solar activity was compared with the observed $^{14}C/^{12}C$ ratio during 1870-1933, a fair anticorrelation between sunspot activity and ^{14}C deviations was found. It is concluded that if the nature of secular variations of $^{14}C/^{12}C$ is considered, it becomes difficult to reach any conclusions that may be of significance to a possible antimatter content of the Tunguska meteorite. (H.G.D.)

9691 THE QUASI BIENNIAL VARIATION OF COSMIC RAYS. Maeda, K.; Suda, T. (Goddard Space Flight Center, Greenbelt, Md.). Pap. Meteorol. Geophys. (Tokyo), 16: 65-75(June 1965). (In French).

The quasibiennial variation of cosmic rays in tropical regions is estimated theoretically; the calculation is based on results obtained by the meteorological investigations of Reed. The largest maximum in the amplitude spectrum is situated in periods from 16 to 60 months, based on data without geomagnetic agitation from Huancayo (12°S). Data from Cheltenham (39°N) show not only seasonal or annual variation but also less intense maxima of about 24 and 40 months. The significance of the maxima in these two cases is not understood. The difference between spectra favors a terrestrial origin for the quasibiennial atmospheric oscillation. (TCO)

9692 ISOTOPIC COMPOSITION OF LOW-ENERGY HELIUM NUCLEI IN THE PRIMARY COSMIC RADIATION AT SOLAR MINIMUM. Hofmann, D. J.; Winckler, J. R. (Univ. of Minnesota, Minneapolis). Phys. Rev. Lett., 16: 109-11(Jan. 17, 1966).

The ratio $^3He/^3He + ^4He$ in primary cosmic radiation was investigated using a scintillation counter flown by balloon from Barrow, Alaska, on May 12, 1965. The dependence of the ratio on energy and rigidity was studied. It was found that the ratio, in terms of energy/nucleon, was constant over the range of 80 to 150 Mev/nucleon. (D.C.W.)

9693 THE INTENSITY AND ANGULAR DISTRIBUTION OF COSMIC RAYS FAR UNDERGROUND. Achar, C. V.; Narasimham, V. S.; Murthy, P. V. Ramana; Creed, D. R.; Pattison, J. B. M.; Wolfendale, A. W. (Tata Inst. of Fundamental Research, Bombay). Proc. Phys. Soc. (London), 86: 1305-15(Dec. 1965).

An apparatus incorporating scintillators, Geiger counters and neon flash-tubes was operated at three locations underground in the Kolar Gold Fields, India, to measure the vertical intensity and angular distributions of penetrating cosmic muons. The intensities at the three depths (816, 1812 and 4100 metres water equivalent of rock) are, respectively; $(2.39 \pm 0.15) \times 10^{-6}$, $(2.00 \pm 0.12) \times 10^{-7}$ and $(4.63 \pm 0.57) \times 10^{-9}$ cm^{-2} sec^{-1} $sterad^{-1}$. The angular distributions are well represented by expressions of the form $I(\theta) = I(0)\cos^n\theta$, where θ is the zenith angle, and the values of n at the successive depths are 1.93 ± 0.22, 3.03 ± 0.16 and 5.12 ± 0.82. (auth)

Direct Energy Conversion

Refer also to abstracts 9300, 9309, and 10406.

9694 (ANL-6954) LIQUID MHD POWER CYCLE STUDIES. Petrick, Michael; Lee, Kung-You (Argonne National Lab., Ill.). June 1965. Contract W-34-109-eng-38, 91p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

The potential of liquid-metal MHD power cycles was investigated by means of extensive cycle studies and was found to be excellent. An overall efficiency of a binary cycle employing a liquid metal topping cycle and a bottoming steam cycle approaching 60% may be feasible. Detailed analyses and cycle data are presented. The potential of the binary cycle for commercial application is discussed. (auth)

9695 (EGG-1183-2043) ACCOMPLISHMENTS OF COMPTON STUDIES PROGRAM, FISCAL YEAR 1965. Artuso, J. F. (Edgerton, Germeshausen and Grier, Inc., Santa Barbara, Calif.). Sept. 1965. Contract AT(29-1)-1183. 48p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

The theory used to calculate the quantum efficiency of various metals as a function of incident photon energy is presented. The conclusions drawn from this theory were found to be in very good agreement with experimental data. For low-Z materials the calculated quantum efficiency is within 2 percent of the measured value. A theoretical discussion of the resolution of an electrostatic retarding field spectrometer is also presented, and a number of integral electron spectrum curves are shown. (auth)

9696 (IAE-950) NEKOTORYE DANNYE PO ISSLEDOVANIYU RABOTY TERMOEMISSIONNOGO PREOBRAZOVATELYA S DOPOLNITEL'NOI IONIZATSIEI. (Certain Data on Investigation of Performance of Thermoemission Converter with Auxiliary Ionization). Kravchenko, Yu. Ay.; Stolyarov, G. A. (Institut Atomnoi Energii, Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow). 1965. 7p. Dep. mn.

The possibility of realization of a low-temperature thermoemission converter of thermal into electric energy is considered. Some experimental data on the effect of auxiliary ionization on the short-circuit current and the specific power of the converter are presented. Tests were carried out on an experimental converter in the interelectrode gap of which is located a filament made incandescent by a semi-rectified current. The short-circuit current and the specific power were increased 100- and 20-fold, respectively, for filament temperature up to 1640°C. (tr-auth)

9697 (NASA-CR-349) ADSORPTION OF CESIUM ON INSULATORS. Levine, Jules D. (RCA Labs., Radio Corp. of America, Princeton, N. J.). Dec. 1965. Contract NAS-3-4173. 38p. CFSTI $2.00 cy, $0.50 mn.

Starting from fundamental quantum mechanical concepts, theoretical wave functions, donor ionization energies, tunneling energies, conductivity relationships, and equations of state, all in excellent agreement with extensive experimental data, were derived. The ground state wave function of a cesium atom on a dielectric surface was theoretically determined to be one lobe of a 2p hydrogenic wave function penetrating deep into the dielectric, and general rules for selecting surface wave functions of all excited states and arbitrary surface asymmetry were derived. Cesium-cesium interactions were explicitly calculated using Kopi-

neck's resonance integral between neighboring wave functions. Conductivity proceeds via cesium-cesium electron tunneling and the conductivity relationship was derived in terms of Kopineck's integral and the surface phonon transitions which supply the conductivity loss mechanism. Phonon energies were explicitly calculated from the vibrational motion of surface atoms. The conductivity varied as the cesium coverage squared, to a first approximation. An equation of state was derived showing the linear dependence of coverage and arrival rate for the low coverage system of interest. The conductivity was then predicted to be proportional to the cesium pressure squared, and this prediction was accurately verified experimentally. By comparing other aspects of theory and experimental data, the heat and entropy change of adsorption were unambiguously calculated. For surfaces probably contaminated with hydrogen, conductivity increased above the nonhydrogenated case. It was concluded that the Arrhenius form of experimental data is convenient for calculating cesium conductivity in various thermionic energy converters and related test apparatus. Sophisticated means were developed for analyzing the Arrhenius coefficients with and without contaminants. (P.C.H.)

9698 (NASA-CR-54752) BRAYTON CYCLE CAVITY RECEIVER. DESIGN STUDY. (TRW Equipment Labs., Thompson Ramo Wooldridge Inc., Cleveland, Ohio.). Nov. 22, 1965. Contract NAS-3-2779. 323p. (ER-6497).

The Lewis Research Center of NASA is currently sponsoring studies leading to the design and development of solar dynamic power conversion systems which operate on the Brayton cycle. One of the components required in these systems is a solar absorber. A design study of cavity-type receivers which employ lithium fluoride as the heat storage medium was made. The work effort included design and analysis of full scale flightweight receivers, conduction of a series of small scale experiments and an experimental corrosion properties investigation on selected materials. The results of the full scale design studies and of the small scale experiments are presented. The results of the corrosion investigation are presented elsewhere. (auth)

9699 LINEAR THEORY OF AN MHD OSCILLATOR. McCune, J. E. (Avco-Everett Research Lab., Everett, Mass. Massachusetts Inst. of Tech., Cambridge). Advance. Energy Convers., 5: 221-40 (Nov. 1965).

The linear theory of a-c fluctuations in an MHD channel subject to the Hall instability of Velikhov is explored. It is shown that the system as a whole (plasma, plus boundaries, plus external circuitry) is stable to the Velikhov mode except at certain resonant acoustic frequencies. If these resonant frequencies are excited, channels of sufficient size can be made to oscillate and produce net a-c power. However, nonlinear effects limit the a-c power level severely for this geometry, and adversely affect the d-c performance of the channel. The analysis shows that resonant fluctuations can be controlled by external circuitry. (auth)

9700 THERMIONIC ANALYSIS BY USE OF A DIGITAL COMPUTER. Truscello, Vincent C.; Lieberman, Albert R.; Bustard, Thomas S. (Martin Co., Baltimore). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci., NS-12: 69-76 (Dec. 1965).

An IBM digital computer program was developed to semi-empirically predict thermionic diode performance. Experimental curves of voltage versus current are presented for tantalum, molybdenum, and rhenium for a wide range of emitter and cesium temperatures. These are processed by the program to determine the optimum efficiency characteristics for various emitter temperatures. Graphical presentations of the processed data indicate the maximum obtainable efficiencies using any of the three emitter materials. The corresponding values of cesium temperature and diode voltage necessary to obtain this efficiency and the corresponding power densities are also presented. (auth)

9701 HYPERSONIC PLASMA THERMIONIC GENERATOR [Thesis]. LeBlanc, Andre Rene. Albuquerque, N. Mex., Univ. of New Mexico, 1962. 233p.

The Langmuir two-probe system is extended to cover the case of electron emission from one of the probes. The contact potential difference between the two probes is also included as part of the equations. One of the probes, known as the emitter, operates at sufficiently high temperatures such that electron emission occurs, while the other probe, known as the collector, operates at low enough temperatures that its electron emission can be neglected. A set of balanced current equations is then derived for the emitter and collector. These equations are supplemented by a potential equation derived for the complete electrical loop. The electron gas temperature as well as the difference in work function between emitter and collector can be derived by equating the net current at the emitter to the net current at the collector and then using the potential equation. Knowing the electron temperature, difference in work function, and using an estimated value of gas resistivity, a volt-ampere equation, needed for predicting the electrical output of the generator, can then be calculated. The volt-ampere equation can then be used to derive the electrical power output, as well as the location of maximum power as a function of the current ratio of net current to the electron current emitted at the emitter. A discussion of estimating the resistivity of the plasma is included. The electrical power output of a typical re-entry vehicle is obtained by first solving the temperature history of a thin-walled emitter. To simulate the conditions of re-entry, a test model was built and inserted in a plasma jet. The description of the experimental apparatus and the experimental data, as well as the conclusions, are included. (Dissertation Abstr.)

9702 IMPROVEMENTS IN AND RELATING TO THERMOIONIC ENERGY CONVERTORS. (to Brown Boveri and Co., Ltd.). British Patent 1,011,310. Nov. 24, 1965. Priority date June 20, 1963, Germany.

In a thermoionic energy converter the cathode is positioned within a container, and the inner wall of the container facing the cathode defines an anode. A nuclear fuel element in heat transfer relation with the cathode supplies the heat energy to the emitting cathode. A pump is arranged to circulate an alkali metal vapor, preferably Cs, through the discharge space between the cathode and anode. The pump is accommodated within the container and serves to maintain a closed alkali metal vapor circuit within the container and to maintain working pressure within the discharge space. The temperature of the anode defining walls and of the walls defining the pump housing are capable of being fixed independently of one another. (B.L.M.)

9703 PLASMA JET ENGINE. Hatsopoulos, George N.; Carabateas, Eustratios N. (to Thermo Electron Engineering Corp.). U. S. Patent 3,215,869. Nov. 2, 1965. Filed Dec. 31, 1959.

An apparatus for the conversion of plasma energy to electrical energy includes a source of an ionizable fluid at high temperatures and pressures, a nozzle for the isotropic expansion of the fluid, an expansion chamber in which the plasma is formed, an ionizing means for the fluid, means for creating a magnetic field in the chamber, and a pair of collector electrodes positioned in the chamber. The collector electrodes are composed of magnetic material or are suitably magnetically shielded for orienting the magnetic field perpendicular to the electrode surfaces. Preferably, the ionizing means consists of a high-frequency power supply positioned outside the chamber for producing an electric field in the chamber to ionize the moving plasma without interfering with plasma flow or producing charge loss to the walls of the apparatus. (B.L.M.)

9704 INSULATING MEANS FOR FLOW CHANNEL IN MHD DEVICE. Brill, Edward F. (to Allis-Chalmers Mfg. Co.). U. S. Patent 3,215,870. Nov. 2, 1965. Filed Dec. 26, 1961.

Insulating means for the flow channel in a MHD device comprises heat resistant members having passages for accommodating the flow of a nonconductive gas to effect cooling of the members and to afford an insulating film of gas along the surface of the members. A multiplicity of louvers are provided for communication between the gas passages and the flow channel. The serrated or slotted surface of the heat resistant members serves to reduce the

electrical conductivity across the members and to reduce Hall effects in the channel. The members have a modular form to aid in their insertion and removal from the device. (B.L.M.)

9705 STRUCTURAL FEATURES OF MHD ELECTRICAL POWER GENERATOR. Brill, Edward F. (to Allis-Chalmers Mfg. Co.). U. S. Patent 3,215,871. Nov. 2, 1965. Filed Dec. 26, 1961.

A MHD device includes a magnetizable body composed of a number of discrete members in stacked relationship along the axis of the body having a passageway extending axially through the body. Certain of the stacked members have radially disposed openings that communicate with the passageway. A magnetic coil disposed in the passageway is energizable to produce a magnetic field transversely through the passageway. Insulating means within the passageway define two opposite sides of a flow channel for hot electrical gases, and consumable electrode means extending through openings in the stacked members are adapted to be extended into the passageway to define two opposite sides of the flow channel. (B.L.M.)

9706 SPIRAL MAGNETOHYDRODYNAMIC GENERATOR. McLafferty, George H. (to United Aircraft Corp.) U. S. Patent 3,217,190. Nov. 9, 1965. Filed Oct. 3, 1961.

A spiral MHD generator is described that has substantially concentric partitions with means for accelerating the working fluid as it passes through each stage or partition. The variation of the radial electric current can be controlled so as to obtain maximum efficiency in all regions of the device. The annular partitions provided between the walls for dividing the annular space between the walls include openings to provide communication between the divided portions of the path. (B.L.M.)

9707 ELECTRODE MEANS FOR MHD DEVICE. Brill, Edward F. (to Allis-Chalmers Mfg. Co.). U. S. Patent 3,219,852. Nov. 23, 1965. Filed Dec. 26, 1961.

Design of a consumable electrode is patented for a MHD device of modular design having a tapering flow channel in which the electrodes also serve as ablatable wall surfaces of the flow channel. The electrodes are formed of electrically conductive consumable material in particulate form, such as coal or the like, compacted, extruded, or otherwise formed into consumable electrodes that are automatically fed into the flow channel of the MHD device. (B.L.M.)

Elementary Particles and Radiations

See also Field Theory, Scattering Theory, and Symmetries

Refer also to abstracts 9873, 9992, and 10095.

9708 (CERN–65-7(Rev.)) BARYON RESONANCES. Tripp, Robert D. (European Organization for Nuclear Research, Geneva (Switzerland)). Feb. 10, 1965. Revised April 15, 1965. 73p. Dep. mn.

Elementary scattering theory is outlined. A discussion of the Breit-Wigner equation is given with particular emphasis on those characteristic aspects that are identifiable in scattering experiments. As a specific example the $Y_0^*(1520)$ is discussed in detail. Other baryon resonance are discussed with emphasis on those that have been discovered more recently and those whose quantum numbers are still uncertain. (C.E.S.)

9709 (COO–427-42) ISOVECTOR FORM FACTOR OF THE NUCLEONS. Buoncristiani, A. M.; DeCelles, Paul C. (Notre Dame Univ., Ind.). [1964]. Contract AT(11-1)-427. 8p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

The behavior of the electromagnetic form factors as a function of momentum transfer is considered. Specifically, it is shown that a single resonance in the $J = T = 1$, $\pi - \pi$ form factor at 765 Mev with a width of 120 Mev may be sufficient to explain the data if inelastic effects are included in the $\pi - \pi \rightarrow N + \bar{N}$ amplitude. (D.C.W.)

9710 (IC/65/87) REGGE POLES IN QUANTUM ELECTRODYNAMICS. Pradhan, T.; Pattnaik, Mamata (International Centre for Theoretical Physics, Trieste (Italy)). Dec. 1965. 12p. Dep. mn.

With a view to investigating the large momentum transfer limits of Compton scattering amplitude, the perturbation theory matrix elements for the scattering of massive photons (mass = λ) by electrons are considered. Since setting $\lambda = 0$ in the asymptotic limits of these matrix elements need not necessarily give the desired answer because of the two different limiting procedures involved, one separates those parts of the matrix elements that diverge on setting $\lambda = 0$ from the rest that remains finite, keep λ finite but small compared to m (electron mass) in the former, set $\lambda = 0$ in the latter and then obtain the large momentum transfer limits of both separately. It is found that up to 6th order in perturbation theory the large momentum limits are consistent with Regge asymptotic behavior. The Regge parameter $\alpha(W)$ has a λ-dependent part for $W > m$ which diverges logarithmically for $\lambda \rightarrow 0$. The matrix element corresponding to this part in $\alpha(W)$ is cancelled by terms arising from corrections to the scattering amplitude due to emission of real soft photons from external electron lines. Since these corrections depend on the resolution of the apparatus for detecting the soft photons, the location of the Regge trajectory for $W > m$ will depend on the experimental arrangement. However, for $W = m$ and in the immediate vicinity of it $\alpha(W)$ has no λ-dependent part (this is in keeping with the fact that infra-red divergence does not arise when the particles are off the mass shell). The trajectory is, therefore, well defined near $W = m$ and has the definite value zero at $W = m$. One therefore concludes that the electron is a Regge pole. (auth)

9711 (INR–623/VII/PH) THE $SU_2 \otimes SU_3$ CONTENT OF THE SU_6 REPRESENTATIONS. Grynberg, M.; Pindor, M. (Institute of Nuclear Research, Warsaw (Poland)). Apr. 1965. 14p. Dep.

On the basis of the connection between the linear group and the permutation group, a method was formulated for finding the $SU_2 \otimes SU_3$ content of an irreducible representation of SU_6. Results were obtained for tensors of rank 3, 6, and 9. (D.C.W.)

9712 (JEN–161-DF/I-50) DIFUSION ELASTICA ANTIPROTON-PROTON A 3,0 Y 4,0 Gev/C. (Antiproton-Proton Elastic Scattering at 3.0 and 4.0 Gev/C). Unamuno, Salome (Junta de Energia Nuclear, Madrid (Spain). Division de Fisica). 1965. 76p. Dep. mn.

The elastic scattering of antiprotons by protons at 3.0 and 4.0 Bev/c was investigated by observing two-prong interactions in a hydrogen bubble chamber exposed to antiproton beams. The elastic and total cross sections were obtained at both energies. The results were compared with data on antiproton-proton scattering at different energies and on proton-proton scattering. Interpretation of the results by several optical models was attempted. (D.C.W.)

9713 (NP-15787) ELEKTROROZHDENIE IZOBARY $N_{3/3}(1238)$ V SKHEME RELYATIVISTSKOI SU(6) SIMMETRII $(SU(6)_w)$. (Electroproduced Isobars $N_{3/3}$ (1238) in Relativistic SU(6) Symmetry $SU(6)_w$ System). Report No. 377. Geshkenbein, B. V. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki). 1965. 7p. Dep. mn.

The cross section for the electroproduction of the $N_{3/3}^*$ resonance was calculated on the basis of a relativistic SU(6) symmetry. The transition form factor and the proton magnetic form factor were evaluated and were found to coincide in the range of momentum transfer from $q^2 = 2F^{-2}$ to $100F^{-2}$. (D.C.W.)

9714 (NP-15792) O VYROZHDENII PO BARIONNOMU ZARYADU V MODELI KVARKOV S ZARYADOVOCHETNYMI MEZONAMI. (Degeneration With Respect to Baryon Charge in a Quark Model With Charge-Variant Mesons). Report

No. 330. Okun, L. B. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki). 1965. 4p. Dep. mn.

A model of quarks interacting by exchange of neutral scalar mesons is considered. It is shown that in this model degeneration between states with different values of baryonic charge takes place. In particular, the masses of diquarks must be equal to the masses of mesons, and the masses of physical quarks must be equal to the masses of the baryons. (auth)

9715 WHY WE STUDY HIGH-ENERGY NUCLEAR PHYSICS. Powell, C. F. (Univ. of Bristol, Eng.). Advance. Sci., 21: 514-21(Mar. 1965).

Past, present, and possible future developments in particle physics are reviewed, and needs for future research are discussed. Solution of present problems will require a considerable increase in technical resources now available. Thus the field quanta of the weak interactions, if they exist, are of such a nature that experiments with beams of neutrinos much more energetic than those which now can be generated with present machines will be necessary for their discovery. (TCO)

9716 POSSIBILITY FOR A LARGE SPIN-FLIP PART IN THE SCATTERING AMPLITUDES OF K^-p CHARGE EXCHANGE AT 9,5 Gev/c. Fischer, Walter E. (CERN, Geneva). Helv. Phys. Acta, 38: 629-32(Oct. 1965).

An attempt is made to explain the experimentally observed anomalous behavior of the momentum transfer distribution in K^-p charge exchange at small t by the hypothesis of a strong spin-flip in the scattering amplitude. The ratio of spin-flip to non-spin-flip terms is obtained as a function of momentum transfer, by a parametrization from comparing experimental and theoretical differential cross sections, and is compared with the ratio derived using the peripheral $N\rho N$-coupling model. The relatively strong spin-flip term in this coupling is still smaller than that demanded by the parametrization. (M.J.T.)

9717 REGULARIZATION OF THE CHEW-LOW EQUATIONS FOR THE $\pi + N \rightarrow 2\pi + N$ PROCESS IN FIXED NUCLEON APPROXIMATION. Islamov, M. F.; Khodzhaev, L. Sh. (Tashkent Electrotechnical Inst. of Communication). Izv. Akad. Nauk Uz. SSR, Ser. Fiz.-Mat. Nauk, No. 1, 60-8 (1965). (In Russian).

Dispersion relations derived previously for the amplitude of the inelastic process $\pi + N \rightarrow 2\pi + N$ for fixed nucleon are examined. Equations for this process obtained using the dispersion relations are found to differ substantially from the analogous Chew-Low equations. The Chew-Low type equations obtained for the amplitude in both approximations have symmetry properties depending on the energies of the incident and emitted pions. Expressions for vectors depending on the real and imaginary parts of the amplitude are obtained from the one-dimensional dispersion relation. The regularization of these expressions by the Karleman method is studied, under different assumptions on the Hölder-type matrices appearing in them. (M.J.T.)

9718 THE QUARK HYPOTHESIS AND RELATIONS BETWEEN CROSS SECTIONS AT HIGH ENERGIES. Levin, E. M.; Frankfurt, L. L. (Ioffe Physico-Technical Inst., Moscow). JETP Lett. (USSR) (Engl. Transl.), 2: 65-7(Aug. 1, 1965).

A physically lucid approach to the account of symmetry in particle interactions at high energies is proposed. It is assumed that the particles are made up of quarks and that the wave function of the free particles transforms in accordance with SU(6) symmetry in the particle rest frame. It is also assumed that the fast particle collision process consists principally of single particle scattering of a quark of one particle by a quark of the other. The validity of such an approximation is explained by means of a model. (J.F.P.)

9719 ON A POSSIBLE CLASSIFICATION OF ELEMENTARY PARTICLES IN THE QUARK MODEL. Azimov, Ya. I.; Anisovich, V. V.; Ansel'm, A. A.; Danilov, G. S.; Dyatlov, I. T. (Ioffe Physico-Technical Inst., Moscow). JETP Lett. (USSR) (Engl. Transl.), 2: 68-70(Aug. 1, 1965).

The quark model is used to classify baryons and mesons. It is noted that there are facts that fit the framework of the simple model, according to which the elementary particles consist of nonrelativistic quarks, namely, the connection between the mass differences in various meson and baryon multiplets, and the equality of the magnetic moments of the proton and of the $\omega \rightarrow \pi + \gamma$ transition. From the point of view of such a model, the particle classification presented is perfectly probable, whereas the predicted mass values are estimates. The main feature of the scheme is that it includes almost all presently known resonances. (J.F.P.)

9720 DEPENDENCE OF THE SLOPE OF THE DIFFRACTION CURVES OF pp, $\bar{p}p$, K^+p, K^-p, π^+p, AND π^-p SCATTERING ON THE ENERGY. Lyubimov, A. L. JETP Lett. (USSR) (Engl. Transl.), 78-83(Aug. 1, 1965).

It was shown previously that starting with several Bev and continuing up to the highest energies attained in accelerators, the diffraction peaks shrink in elastic pp and K^+p scattering, but there is no shrinkage in π^+p and K^-p scattering, and for $\bar{p}p$ scattering the diffraction cone even broadens with increasing energy. It is shown that in spite of the lack of similarity in the behavior of the diffraction-curve slopes in these elastic scattering processes in the energy region indicated, this behavior can be described, within the limits of experimental accuracy, in a unified fashion. This description starts from the notion that the diffraction cone shrinks with increasing energy for all processes, and from an account of the effect of the total interaction on the shape of the diffraction curve. The possibility of describing the experimental data by means of a relation similar to that derived demonstrates the correctness of the predictions of the pole model of the theory of complex angular momenta concerning the asymptotic behavior of the diffraction cones. (J.F.P.)

9721 MONOTONICITY OF THE DECAY OF UNSTABLE PARTICLES CORRESPONDING TO AN n-ORDER POLE. Khalfin, L. A. (Steklov Mathematics Inst., Leningrad). JETP Lett. (USSR) (Engl. Transl.), 2: 87-8(Aug. 1, 1965).

It is proven that the energy distribution of unstable particles corresponding to a pole of order n belongs to the class of energy distributions of physical systems. It is found that the energy distribution corresponding to a pole of order n is acceptable, for arbitrary n, as the energy distribution of an unstable particle, inasmuch as the decay law is monotonic. (J.F.P.)

9722 CONCERNING THE DIFFERENCE BETWEEN ν_μ AND ν_e. Ushakov, V. V. (Khar'kov State Univ.). JETP Lett. (USSR) (Engl. Transl.), 2: 115-17(Aug. 15, 1965).

Two questions are considered. The first is whether it has been proved that a neutrino-antineutrino pair is emitted when the meson decays, and consequently that the lepton charges of the negative meson (μ) and the electron are equal. The second is whether the results of a CERN experiment and the absence of the $\mu \rightarrow e + \gamma$ decay require the existence of two types of neutrinos. (J.F.P.)

9723 RELATIVISTIC GENERALIZATION OF SU(6) SYMMETRY AND PRODUCTION OF BARYON RESONANCES. Zakharov, V. A.; Kaidalov, A. B. (Nuclear Physics Div., Academy of Sciences, USSR). JETP Lett. (USSR) (Engl. Transl.), 2: 121-4(Aug. 15, 1965).

The production of the isobar pertaining to the decuplet is considered on the basis of U(12) symmetry of strong interactions. It is shown that in the reaction $K^+ + p \rightarrow N^{*++} + K^0$ the predicted angular distribution coincides with that obtained previously. In the reaction $\pi^+ + p \rightarrow N^{*++} + \pi^0$ the angular correlations have the same form, provided the principal role is played in the t channel by exchange of states with T = 1 and not 2. These deductions are not connected with the assumption regarding the peripheral character of the interaction. The relativistic generalization of SU(6) symmetry leads to the same results. (J.F.P.)

9724 PARITY NONCONSERVATION EFFECTS INDUCED BY WEAK INTERACTIONS IN NUCLEAR AND ELECTROMAGNETIC FORCES. Lipmanov, E. M. (Volgograd Pedagogical Inst.). JETP Lett. (USSR) (Engl. Transl.), 2: 127-30(Sept. 1, 1965).

Attention is called to several characteristic predictions with respect to parity nonconservation effects in nuclear and electromagnetic forces which appear when the model of Lipmanov (JETP 47: 360 (1964), and Soviet Phys. JETP 20: 239 (1965)) is generalized. (J.F.P.)

9725 DOUBLE BREMSSTRAHLUNG IN ELECTRON COLLISIONS. Baier, V. N.; Galitskii, V. M. (Novosibirsk State Univ., USSR). JETP Lett. (USSR) (Engl. Transl.), 2: 165-7(Sept. 15, 1965).

The results of a calculation of the cross section for the emission of two photons with arbitrary energy in electron-electron and electron-positron collisions are presented. This question is of great interest in connection with colliding beam experiments. (J.F.P.)

9726 POLARIZATION OF PROTONS SCATTERED FROM DEUTERONS. Grueebler, W.; Haeberli, W.; Extermann, P. (Univ. of Wisconsin, Madison). Nucl. Phys., 77: 394-400(1966). (COO-7-0359; COO-7-0364).

The polarization of protons elastically scattered from deuterons was measured by observing the left-right ratio when the polarized proton beam from a tandem accelerator was scattered from a gaseous deuterium target. Measurements were carried out in the energy range from 3 to 10 Mev and at center-of-mass angles of 66.3, 85.9, 104.0, 120.0, and 141.8°. The polarization is positive at all angles and energies measured. In the forward hemisphere the polarization is almost independent of bombarding energy and less than 0.08. At 10 Mev a maximum in the polarization of 0.15 was observed at 120°. For most of the measurements the uncertainty in the measured polarization is 0.01 or less. (auth)

9727 SPIN CORRELATION EXPERIMENTS IN PROTON-PROTON SCATTERING AT 380 Mev. Allaby, J. V.; Chisholm, A.; Eades, J.; James, A. N. (Univ. of Liverpool). Nucl. Phys., 77: 449-64(1966).

Measurements of the spin correlation parameters C_{nn} and C_{kp} for 45° center-of-mass proton-proton scattering are described. The measurements were made using counter techniques to detect asymmetries following simultaneous rescattering of both protons in carbon polarization analyzers. The results obtained were $C_{nn} = +0.30 \pm 0.10$ and $C_{kp} = +0.10 \pm 0.08$. (auth)

9728 MONTE CARLO CALCULATIONS OF SPURIOUS ASYMMETRIES IN SPIN CORRELATION EXPERIMENTS. Eades, J. (Univ. of Liverpool). Nucl. Phys., 77: 465-71(1966).

A Monte Carlo calculation of the instrumental asymmetry in correlation experiments described previously is given. This calculation includes the effect of multiple scattering material in the path of the lower energy proton from the p-p scattering. As expected, the result was to reduce the value of the instrumental asymmetry. (auth)

9729 PION-NUCLEON RESONANCES AND THE ANGULAR DISTRIBUTION IN PION ELECTROPRODUCTION. Jones, H. F. (Harvard Univ., Cambridge, Mass.). Nuovo Cimento (10), 40A: 1018-33(Dec. 21, 1965).

The helicity formalism is used to find the contributions from final states of definite spin and parity, together with the interference terms between different final-state contributions, to the angular distributions of pions electroproduced from protons. For a single resonant final state the azimuthal terms turn out to be particularly simple and may well serve as a test for the spin of the resonance. It is shown that the angular distribution may be used to detect the possible presence of a $p_{\frac{1}{2}}$ resonant state in the energy region of the second resonance. (auth)

9730 THE ONE-PION EXCHANGE MODEL AND AN ATTEMPT TO MEASURE THE SPIN OF THE f^0. Gelfand, N.; Luetjens, G. (Columbia Univ., N. Y.). Nuovo Cimento (10), 40A: 1034-40(Dec. 21, 1965).

Data on π-π scattering distributions from the reaction $\pi^{\pm} + N \rightarrow \pi^{+} + \pi^{-} + N$ are compiled. For each 50 Mev interval in $\pi\pi$ mass the $\pi\pi$ angular distribution is fitted to a polynomial in cos $\theta_{\pi\pi}$. The simple one-pion-exchange model fails to explain the π-π angular distribution in the ρ^0 mass region. By using the calculations of Gottfried and Jackson a fair agreement is obtained. Above 1150 Mev in $\pi\pi$ mass $\cos^4 \theta_{\pi\pi}$ terms are needed. The coefficient of cos $\theta_{\pi\pi}$ shows no evidence of a resonant shape in the f^0 region; it does not decrease until well past the f^0 mass. (auth)

9731 DYNAMICS OF T = 2 Σ-π SYSTEM. I. Vasavada, Kashyap V. (Goddard Space Flight Center, Greenbelt, Md.). Nuovo Cimento (10), 40A: 1045-54(Dec. 21, 1965).

A dynamical calculation using Balázs type N/D method is performed for the T = 2 Σ-π system in $P_{\frac{3}{2}}$ state. Self-consistent solutions for the position and residue of a resonance are obtained for a wide range of the relevant Yukawa coupling constants and different sets of matching points. Some remarks are made regarding interpretation of the results. (auth)

9732 PRIMAKOFF EFFECT AND π^0 LIFETIME. Bellettini, G. (Univ., Pisa); Bemporad, C.; Braccini, P. L., Foa, L. Nuovo Cimento (10), 40A: 1139-70(Dec. 21, 1965).

The results of an experiment to measure the π^0 lifetime via the inverse decay process (Primakoff effect) are presented. The coherent photoproduction of neutral pions in the reaction $\gamma + Pb \rightarrow \pi^0 + Pb$ was measured with very high angular resolution with a π^0 detector containing 10 independent counting channels, at the two mean energies 950 and 1000 Mev, using the bremsstrahlung beam of the Frascati electron synchrotron. The angular distributions show a characteristic bumping around the forward direction, giving conclusive evidence for the existence of the Primakoff effect. The results are interpreted in terms of two amplitudes — the electromagnetic and the nuclear one — adding up coherently to give the over-all coherent cross section. Such a cross section is expressed in terms of four unknown parameters: the lifetime τ, the phase δ between the electromagnetic and nuclear amplitude, the strength C of the nuclear amplitude, and the nuclear radius R_0. Neutral-pion reabsorption inside nuclear matter is taken into account, and a χ^2 analysis of the data is done in terms of τ, δ, C, and R. The best fit τ value is $(0.73 \pm 0.105) \cdot 10^{-16}$ sec. Systematic errors, as well as the sensitivity of the results to the model used to interpret the data, are extensively discussed and conservatively taken into account. (auth)

9733 EFFECTIVE-RANGE ANALYSIS OF LOW-ENERGY $\bar{K}N$ INTERACTIONS. Warty, M. D. (Univ. of Delhi). Nuovo Cimento (10), 40A: 1206-11(Dec. 21, 1965).

It is found that the effective-range analysis of the $\bar{K}N$ interaction as done by Chand may not be valid over a wide momentum range. However, under the assumption that the effective-range analysis done over a momentum range 0 to 300 Mev/c may be correct, scattering lengths at different momenta are calculated using the experimental scattering length values of Kim and the scattering length obtained if the Y_0^* (1405 Mev) is considered as a $\bar{K}N$ bound state. The Σ^-/Σ^+ ratio calculated using these scattering lengths is found to agree with the experiments. The real part of the effective range turns out to be of the order of $1/m$ (Y_0^*) which demonstrates the important role played by Y_0^* in the K^-p low-energy interactions. (auth)

9734 SINGLE REGGE POLE ANALYSIS OF K^-p CHARGE EXCHANGE SCATTERING. Roy, D. P. (Tata Inst. of Fundamental Research, Bombay). Nuovo Cimento (10), 40A: 1212-15(Dec. 21, 1965).

It is shown that the parameters of a ρ Regge-pole exchange model can correctly reproduce the energy and momentum-transfer dependence and the absolute magnitude of the amplitude for K^-p charge-exchange scattering at 9.5 Bev/c. An expression for the differential cross section is obtained from the equations for the ρ-trajectory exchange contribution to the invariant charge-exchange scattering amplitude and for the ρ-meson exchange amplitude

at the pole point. Results of numerical evaluation of the differential and total cross sections are compared with experimental results and the predictions of the absorption model. (M.J.T.)

9735 THE $(56,\overline{56})^-$ CONTRIBUTION TO THE NUCLEON FORM FACTORS. Delbourgo, R.; White, R. (International Centre for Theoretical Physics, Trieste). Nuovo Cimento (10), 40A: 1228-32(Dec. 21, 1965).

The contribution to the nucleon electromagnetic form factors from the $(56,\overline{56})$ negative-parity multiplet is evaluated by $\tilde{U}(12)$ theory, assuming that the photon couples to the SU(6) 35 in the pole approximation. The phenomenological status of these form factors is reviewed briefly. The calculation is sketched, and the consequences of the resulting small correction are examined in detail. (M.J.T.)

9736 CALCULATIONS ON INELASTIC ELECTRON DEUTERON SCATTERING. Breitenlohner, P.; Hoelzl, K.; Kocevar, P. (Univ., Graz). Phys. Lett., 19: 54-6 (Sept. 15, 1965).

Inelastic electron-deuteron scattering was studied using a Hulthen wave function with a hard core of 0.43 fm. Completely relativistic kinematics were used for the non-interfering terms, and the small interference terms were calculated using Foldy-Wouthuysen transformed currents. The influence of the final-state corrections and of the gradient terms was investigated. (D.C.W.)

9737 THE STRANGENESS CHANGING AXIAL VECTOR COUPLING CONSTANT. Pandit, L. K.; Schechter, J. (Univ. of Rochester, N. Y.). Phys. Lett., 19: 56-9 (Sept. 15, 1965). (UR-875-93).

The strangeness-changing axial vector coupling constants for $\Lambda \rightarrow pe\nu$ and $\Sigma^0 \rightarrow pe\nu$ were calculated using the Fubini-Furlan-Adler-Weisberger technique without assuming SU(3) invariance. It was found that Cabibbo's factor of $\sin\theta$ in the effective weak current can not be explained as a renormalization effect, but must be initially present in the unrenormalized weak current. The results, however, were in reasonable agreement with Cabibbo's theory. (D.C.W.)

9738 CALCULATION OF THE F/D RATIO ON THE BASIS OF CURRENT COMMUTATION RELATIONS. Amati, D. (Univ., Modena, Italy. CERN, Geneva); Bouchiat, C.; Nuyts, J. Phys. Lett., 19: 59-62(Sept. 15, 1965).

Using sum rules derived from the algebra of current components and the Goldberger-Treiman relation, an expression for the D/F ratio and a consistency relation between integrals over absorptive forward amplitudes were obtained. The empirical evaluation of the integrals gave results in agreement with the consistency relation and a D/F value of 2.7, which is quite compatible with experimental data. (G.O.Y.)

9739 A MODEL FOR πN ELASTIC AND CHARGE EXCHANGE SCATTERING AT HIGH ENERGY. Cohen-Tannoudji, G.; Morel, A.; Navelet, H. (CEN, Saclay, France). Phys. Lett., 19: 62-4(Sept. 15, 1965).

A model for high-energy pion-nucleon elastic and charge-exchange scattering is proposed in which a few dominant Regge poles are retained and are combined with a phenomenological inelasticity parameter to account for other processes. (D.C.W.)

9740 DIPION RESONANT SYSTEMS PRODUCED IN 4.5 Gev/c π^+d INTERACTIONS. Forino, A. (Univ., Bologna. I.N.F.N., Bologna); Gessaroli, R.; Lendinara, L.; (and others). Phys. Lett., 19: 65-7(Sept. 15, 1965).

The production of resonances in meson (π^+)-deuteron interactions at 4.5 Bev/c was investigated using a deuterium-filled bubble chamber. The analysis of the observed mass distributions is outlined. (D.C.W.)

9741 DOUBLE PION PRODUCTION IN π^+d INTERACTIONS AT 4.5 Gev/c. Forino, A. (Univ., Bologna. I.N.F.N., Bologna); Gessaroli, R.; Lendinara, L.; (and others) Phys. Lett., 19: 68-72(Sept. 15, 1965).

The behavior of the two- and three-body systems in the following reactions was studied: $\pi^+d \rightarrow d\pi^+\pi^+\pi^-$; $\pi^+p(n) \rightarrow p\pi^+\pi^-(n)$; $\pi^+n(p) \rightarrow n\pi^+\pi^+\pi^-(p)$; and $\pi^+n(p) \rightarrow p\pi^+\pi^-\pi^0(p)$. The production mechanism of the A_2 resonance was also investigated from the cumulative results. (G.O.Y.)

9742 ELASTIC DIFFERENTIAL CROSS SECTIONS FOR π^+p AT 1.76 AND 2.08 Gev/c. James, F. E.; Johnson, J. A.; Kraybill, H. L. (Yale Univ., New Haven. Brookhaven National Lab., Upton, N. Y.). Phys. Lett., 19: 72-4 (Sept. 15, 1965).

The differential cross sections for elastic meson(π^+)-deuteron interactions at 1.76 and 2.08 Bev/c were measured over a range of angles. The maximum-likelihood method was used to fit the forward peaks at each energy by three models. (D.C.W.)

9743 MASS, WIDTH, AND BRANCHING FRACTION OF Y*(1385). Armenteros, R. (CERN, Geneva); Ferro-Luzzi, M.; Leith, D. W. G.; (and others). Phys. Lett., 19: 75-7(Sept. 15, 1965).

Strong production of Y*(1385) in the channels $K^- + p \rightarrow \Lambda + \pi^+ + \pi^-$ and $K^- + p \rightarrow \Sigma^0 + \pi^+ + \pi^-$ was observed in a study of K^- + p interactions at momenta of 950 to 1200 Mev/c. The mass difference $(Y^{*-} - Y^{*+})$, the Y* width, and the branching ratio for the decay $Y^* \rightarrow \Sigma\pi$ were evaluated from the data. (D.C.W.)

9744 OBSERVATION OF A NON-ELASTIC COSMIC RAY NEUTRINO INTERACTION. Achar, C. V. (Tata Inst. of Fundamental Research, Bombay); Menon, M. G. K.; Narasimham, V. S.; (and others). Phys. Lett., 19: 78-80(Sept. 15, 1965).

An interaction was observed in the underground neutrino telescopes at the Kolar Gold Mines in south India which appears to be a non-elastic cosmic neutrino interaction. The event is discussed in detail. (G.O.Y.)

9745 COHERENT PRODUCTION OF MULTIPION FINAL STATES IN 6 TO 18 Gev/c π^- INTERACTIONS WITH NUCLEI. Allard, J. F. (Univ. Paris, Orsay, France. Ecole Polytechnique, Paris); Drijard, D.; Hennessy, J.; (and others). Phys. Lett., 19: 431-4(Nov. 15, 1965).

Experimental evidence is presented for the occurrence of meson (π) diffraction dissociation, that is, of coherent production of multimeson (π) final states in the meson (π) nucleus interactions. The experiment was performed with a bubble chamber of propane-freon mixtures exposed to a 6- to 18-Bev/c meson (π^-) beams. The production of meson systems with the differential cross section distribution expected for coherent production on the target nucleus acting as a whole was observed. These meson systems are mainly 3π of charge -1. The abundant production of the A1 state is in agreement with the expected J^P selection rules. Thus experimental results are well described by the simple model of coherent multimeson (π) production. A least squares fit to the experimental slope of the differential cross section for $\pi^+\pi^-\pi^-$ production gives an rms radius of 3.1 ± 0.4 for fluorine and 3.4 ± 1.0 for carbon. (J.F.P.)

9746 MESON-NUCLEON COUPLING CONSTANTS FROM PROTON-PROTON SCATTERING ANALYSIS. Koepp, G.; Kramer, G. Phys. Lett., 19: 593-5(Dec. 15, 1965).

An attempt to determine the nucleon coupling constants of the well established vector mesons ρ, ω and ϕ, the meson (η) and a recently discovered scalar I = 0 meson, called s by a best fit to partial wave scattering matrix elements obtained from phase shift analysis of experimental proton-proton scattering data below 300 Mev, is described. It is assumed that unitarity is not important for the small partial wave amplitudes of large angular momenta and that these are entirely given by the one-particle exchange contribution of the mesons with low mass. The main results are summarized. First a $J = 0$ $\pi\pi$ contribution around 400 Mev must be present and second the constants g_{ω_1} and g_{ρ_1} come out in agreement with the SU(6) relation $g_{\omega_1}/g_{\rho_1} = 3$. (J.F.P.)

9747 REGGE TRAJECTORY FROM $\pi^- + p \rightarrow \eta^0 + n$ DATA. Phillips, R. J. N. (Atomic Energy Research Establishment, Harwell, Eng.); Rarita, W. Phys. Lett., 19: 598-9(Dec. 15, 1965).

The results are briefly given for a model-independent analysis for the A_2 trajectory. The reaction $\pi^- + p \rightarrow \eta^0 + n$ at high energy was used as a test of the hypothesis. Two kinds of analysis were made. First, in a separate-t analysis, data at the same momentum transfer were fitted by a least-squares method. Secondly, all t-values were fitted simultaneously. The results for each type of analysis are given. (J.F.P.)

9748 THE PARITY OF N(1925, $^7/_2$) IN A MODEL FOR THE PROCESS $\pi^+ + P \rightarrow \Sigma^+ + K^+$. Feuerbacher, J. L.; Holladay, W. G. (Vanderbilt Univ., Nashville). Phys. Lett., 19: 599-601(Dec. 15, 1965).

Recent studies of the reaction $\pi^+ + p \rightarrow \Sigma^+ + K^+$ indicate that a model consisting of a Λ pole, a K* pole, the $p_{^1/_2}$, 1238-Mev resonance and an $f_{^5/_2}$, 1925-Mev resonance yields fairly good fits to the differential cross section and polarization data up to several hundred Mev above threshold. The assumption that the $g_{^7/_2}$ might be the quantum numbers of the 1925-Mev resonance was considered, with the indication that the assumption gives results far less favorable than the $f_{^7/_2}$ choice for this resonance. The results of a study based on the data at a meson (π) laboratory beam energy of 1090 Mev which show quantitatively the extent of the superiority of the $f_{^7/_2}$ quantum numbers over the $g_{^7/_2}$ possibility in this model are presented. (J.F.P.)

9749 RECIPROCITY: NORMALITY AND CP VIOLATION IN K^0-$\bar{K}^0$ DECAYS. Patil, S. H.; Tomozawa, Y.; Yao, York-Peng (Inst. for Advanced Study, Princeton, N. J.). Phys. Lett., 19: 601-4(Dec. 15, 1965).

A unified approach is presented for some experimental results with reference to CP or T invariance. CPT invariance is assumed throughout the discussion. It is proposed that while time reversal invariance is not valid, reciprocity relations may be true. It is believed that reciprocity provides an attractive alternative to time reversal invariance and deserves attention. (J.F.P.)

9750 THE PRODUCTION OF BOSON RESONANCES IN QUASI-TWO-BODY PROCESSES AND THE COHERENT DROPLET MODEL. Bialas, A. (CERN, Geneva). Phys. Lett., 19: 604-7(Dec. 15, 1965).

The coherent droplet model is applied to the resonance production in quasi-two-body reactions at high energy. The t dependence of the differential cross section in the reactions $\pi + p \rightarrow A + B$, where A is the meson (π) or a meson (π) resonance, and B is the nucleon or a nucleonic resonance is discussed. A coherent droplet model of quasi-two-body interactions implies that the differential cross section for all processes has a t dependence similar to that of elastic scattering and is essentially energy independent. The experimental data as reported seem generally to support this. Variations of the slope from that of elastic scattering can be qualitatively understood by considering the internal structure of the boson resonances produced. (J.F.P.)

9751 SLOPE OF $d\sigma/dt$ DISTRIBUTIONS IN QUASI TWO-BODY INTERACTIONS OF 8 Gev/c POSITIVE PIONS. Deutschmann, M.; Kropp, D.; Schulte, R.; (and others) (Technische Hochschule, Aachen). Phys. Lett., 19: 608-11(Dec. 15, 1965).

It is shown that for interactions of 8 Bev/c positive mesons (π) with protons which proceed through the formation of an intermediate state, the variation of the differential cross section with the square of the four-momentum transfer is essentially exponential and the slope is, in general, about the same as that for elastic scattering. The results were compared with calculations based on the absorption model. For processes in which one meson (π) is exchanged, the calculations are found to agree, in general, with experiment, but for the reactions requiring vector meson exchange the calculations and the experimental results disagree to such an extent that it must be concluded that the absorption model is basically unsound. Differential cross sections versus the four-momentum transfer squared are shown, and total cross sections are given. (J.F.P.)

9752 SPIN, ISOSPIN AND DECAY RATES OF $\bar{K}^*$ (1400). Badier, J.; Demoulin, M.; Goldberg, J.; (and others) (Ecole Polytechnique, Paris). Phys. Lett., 19: 612-15(Dec. 15, 1965).

The $T = {}^1/_2$, $J^P = 2^+$ assignment for $\bar{K}^*$ (1400) is confirmed, and branching fractions for decay into $\bar{K}\pi$, $\bar{K}^*\pi$, $\bar{K}\omega$, $\bar{K}\rho$, and $\bar{K}\eta$ are presented. Meson (K^-)-proton interactions were studied in a bubble chamber exposed to a 3-Bev/c meson (K^-) beam. The data are analyzed, and the results are shown. The production cross sections for the various decay channels, the branching fractions, and the experimental widths, together with previous predictions are given. (J.F.P.)

9753 REAL PART OF THE ZERO-ANGLE ELASTIC PION-NUCLEON SCATTERING AMPLITUDE AND THE CHARGE EXCHANGE CROSS SECTION AT HIGH ENERGIES. Barashenkov, V. S. (Joint Inst. for Nuclear Research, Dubna, USSR). Phys. Lett., 19: 699-700(Jan. 1, 1966).

It was previously established that the mean experimental values of the real part of the π^--p scattering amplitude $D_-(T)$ at energies $T \approx 10$ to 20 Bev decrease much faster than the dispersion relations predict. Results are reported of new dispersion calculations made on JINR computers. (L.B.S.)

9754 REMARKS ON A PARITY DETERMINATION OF THE $Y_1^*(1765)$. Wolters, G. F.; Holthuizen, D. J. (Univ., Amsterdam). Phys. Lett., 19: 701-2(Jan. 1, 1966).

An analysis is made of the data of Armenteros et al. (Phys. Letters, 19: 338 (1965) on the parity determination of the Y_1^* (1765), $J = {}^5/_2$, in which it is shown that both p and f waves, or d and g waves actually contribute in the reaction $Y_1^*(1765) \rightarrow Y_0^*(1520) + \pi^0$. Calculations are made in terms of the helicity formalism. The result is shown to favor odd parity, in qualitative agreement with the conclusion of Armenteros et al. (L.B.S.)

9755 ON THE APPARENT SHIFT OF THE RHO MESON MASS IN PHOTOPRODUCTION. Soeding, P. (Univ., Hamburg). Phys. Lett., 19: 702-4(Jan. 1, 1966).

For two-pion photoproduction, the interference between ρ^0 production and the "Drell mechanism" is shown to shift the apparent rho meson mass by about 25 Mev. This can explain the mass shift experimentally observed for ρ^0 production. (auth)

9756 PROTON-PROTON SMALL-ANGLE SCATTERING AND TOTAL CROSS SECTION AT 10.0 Gev/c. Bellettini, G.; Cocconi, G.; Diddens, A. N.; Lillethun, E.; Scanlon, J. P.; Wetherell, A. M. (CERN, Geneva). Phys. Lett., 19: 705(Jan. 1, 1966).

A new measurement in the angular range 2 to 19 mrad, using an improved system in which sonic spark chamber data were checked by an on-line computer, yielded 40.2 ± 0.3 mb for the total cross section and −0.33 ± 0.035 for the ratio of real to imaginary parts of the forward scattering amplitude. (L.B.S.)

9757 SEARCH FOR THE DECAY $K_2^0 \rightarrow \pi^- + \pi^+ + \gamma$. Nefkens, B. M. K.; Abashian, A.; Abrams, R. J.; Carpenter, D. W.; Fisher, G. P.; Smith, J. H. (Univ. of Illinois, Urbana). Phys. Lett., 19: 706-8(Jan. 1, 1966). (COO-1195-40).

The upper limit (85% confidence) for the decay mode $K_2^0 \rightarrow \pi^- + \pi^+ + \gamma$ is $R = [\text{Rate}(K_2^0 \rightarrow \pi^- + \pi^+ + \gamma)/\text{Rate}(K_2^0 \rightarrow \text{all decay modes})] < 3.0 \times 10^{-3}$ based on an investigation of 3300 K_2^0 decays in flight in a spark chamber experiment. (auth)

9758 EVIDENCE FOR DEVIATIONS FROM ONE-PION EXCHANGE MECHANISM IN ρ^- PRODUCTION. Blieden, H. R.; Focacci, M. N.; Dubal, L.; Kienzle, W.; Lefebvres, F.; Levrat, B.; Maglic, B. C. (CERN, Geneva). Phys. Lett., 19: 708-12(Jan. 1, 1966).

Data obtained with a modified missing-mass spectrometer at 3.0 ± 0.1 and 3.5 ± 0.1 Bev/c on ρ^- production in the reaction $\pi^- + p \rightarrow p + \rho^-$ were analysed in terms of the angle between the incident π^- and the decay π^- measured in the rest frame of the ρ^-, and the Treiman–Yang angle. Details are presented of the method, data, and analysis. The results suggest that states in addition to the ρ^- are involved, that a more complex exchange mechanism may be

occurring, and that the one-pion exchange mechanism without absorption must be modified to account for the complexity of ρ^- production. (L.B.S.)

9759 EVIDENCE FOR A SINGLY CHARGED BOSON OF MASS 1675 Mev AND WIDTH Γ = 66 Mev. Seguinot, J.; Martin, M.; Maglic, B. C.; (and others) (CERN, Geneva). Phys. Lett., 19: 712-14(Jan. 1, 1966).

Evidence is reported for the existence of a boson (R) of charge Q = −1 (isotopic spin I = 1 or 2) decaying into π^- + neutrals and $\pi^-\pi^-\pi^+$ + neutrals, which was obtained in the reaction $\pi^- + p \rightarrow p + R$ at three incident pion momenta 6, 12 and 13 Bev/c. The analysis of the data obtained using the missing-mass spectrometer is discussed. (L.B.S.)

9760 LOW ENERGY $\Lambda p \rightarrow \Lambda p$ CROSS SECTION MEASUREMENT AND DETERMINATION OF S-WAVE SCATTERING LENGTHS. Alexander, G. (Weizmann Inst., Rehovoth, Israel); Benary, O.; Karshon, U.; Shapira, A.; Yekutieli, G.; Engelmann, R.; Filthuth, H.; Fridman, A.; Schiby, B. Phys. Lett., 19: 715-19(Jan. 1, 1966).

The $\Lambda p \rightarrow \Lambda p$ cross section was measured in the Λ-momentum range of 120 to 320 Mev/c using 238 events. A comparison with the effective range approximation yielded the values $a_s = -2.46$, $a_t = -2.07$, $r_s = 3.87$ and $r_t = 4.50$ in fm. (auth)

9761 DETERMINATION OF THE BRANCHING RATIO FOR THE DECAY OF RHO MESONS INTO MUON PAIRS. dePagter, J. K. (Cambridge Electron Accelerator, Mass.); Friedman, J. I.; Glass, G.; Chase, R. C.; Gettner, M.; von Goeler, E.; Weinstein, Roy; Boyarski, A. M. Phys. Rev. Lett., 16: 35-8(Jan. 3, 1966).

The photoproduction of muon pairs from carbon was investigated using a 5.2-Bev bremsstrahlung beam. The data, when compared to the Bethe-Heitler theory, exhibit an enhancement of muon pairs with an invariant mass corresponding to that of the meson (ρ). An estimate of the branching ratio for the decay of mesons (ρ) into muon pairs was obtained. (D.C.W.)

9762 USE OF UNITARITY IN PROVING POMERANCHUK'S THEOREM ON CROSS SECTIONS AT HIGH ENERGIES. Eden, R. J. (Univ. of Maryland, College Park). Phys. Rev. Lett., 16: 39-41(Jan. 3, 1966).

The Pomeranchuk theorem which states that total cross sections for particle-particle and particle-antiparticle scattering become equal in the limit of high energy is proved stressing the importance of the assumptions limiting the rate of change of the difference between particle and antiparticle cross sections and the rate of change of the modulus of the difference between the corresponding amplitudes. It is noted that within certain limits on the rate of change of the total cross sections, the second assumption can be replaced by unitarity. (D.C.W.)

9763 STUDY OF THE REACTION $\pi^- + p \rightarrow \rho^0 + \pi^- + p$ AT 6 Bev/c. Barnes, V. E. (Brookhaven National Lab., Upton, N. Y.); Fowler, W. B.; Lai, K. W.; Orenstein, S.; Radojicic, D.; Webster, M. S.; Bachman, A. H.; Baumel, P.; Lea, R. M. Phys. Rev. Lett., 16: 41-4(Jan. 3, 1966).

The results of a study of the $\rho^0\pi^-$ system in the final state of the interaction $\pi^- + p \rightarrow \pi^- + \pi^- + p^+ + p$ at 6 Bev/c are presented. The results show that there is no peak in the A_1 region when background events involving N*(1240) production are removed and that the events in the $\rho^0\pi^-$ mass region between 1.0 and 1.2 Bev are consistent with peripheral production of the ρ^0 via a one-pion-exchange model. The A_2 meson is clearly evident and is not associated with this type of ρ^0 production. The A_2 meson is observed at a mass of 1290 ±10 Mev with a full width at half maximum of 70 ± 10 Mev. (D.C.W.)

9764 IS A THEORY OF COMBINED POINCARE AND INTERNAL INVARIANCE IMPOSSIBLE. Mirman, Ronald (Long Island Univ., Brooklyn). Phys. Rev. Lett., 16: 58-60(Jan. 10, 1966).

The possibility of finding a Lie group of finite order, containing both the Poincaré group and the SU(3) group as subgroups, that gives a reasonable mass spectrum is considered. (D.C.W.)

9765 DECREASING I = 0, J = 0 $\pi\pi$ PHASE SHIFT AND REGGE GHOSTS. Chew, Geoffrey F. (Univ. of California, Berkeley). Phys. Rev. Lett., 16: 60-3(Jan. 10, 1966). (UCRL-16500).

The possibility that the I = 0, J = 0, $\pi\pi$ phase shift is a decreasing function of energy was considered in detail. (D.C.W.)

9766 EFFECTS OF POLARIZATION ON THE DETECTION OF THE INTERMEDIATE BOSON. Brodsky, S. J.; Kugler, M. (Columbia Univ., New York). Phys. Rev. Lett., 16: 65-7(Jan. 10, 1966).

The effects of polarization on the detection of the intermediate boson were studied. It was concluded that previous results based on the assumption that the W decays isotropically in its center of mass may not be accurate. (G.O.Y.)

9767 IS G PARITY A CONSERVED QUANTUM NUMBER. Vander Velde, J. C. (Univ. of Michigan, Ann Arbor). Phys. Rev. Lett., 16: 69-71(Jan. 10, 1966).

Some experimental data on the strong interactions of S = B = 0 systems were analyzed. It was concluded that the data offer good evidence in favor of I^2 conservation, but do not exclude the possibility that G is not conserved. (D.C.W.)

9768 DETERMINATION OF THE NEUTRON-NEUTRON SCATTERING LENGTH FROM THE REACTION T(d,^{3}He)2n. Baumgartner, E.; Conzett, H. E.; Shield, E.; Slobodrian, R. J. (Univ. of California, Berkeley). Phys. Rev. Lett., 16: 105-8(Jan. 17, 1966).

A determination of the neutron-neutron scattering length by analysis of the ^{3}He spectra from the reaction T(d,He-3) 2n is summarized. (D.C.W.)

9769 MINIMAL CP NONCONSERVATION IN K^0 DECAY. Bowen, Theodore (Univ. of Arizona, Tucson). Phys. Rev. Lett., 16: 112-14(Jan. 17, 1966).

An analysis of a unique possibility of minimal CP noninvariance in K^0 decay is presented which allows retention of CP and T conservation conditions for the K^0 state, but is consistent with the known experimental results for $K_L^0 \rightarrow \pi^+ + \pi^-$. (G.O.Y.)

9770 π^+ CHARGE FORM FACTOR AND ELECTROPRODUCTION. Akerlof, C. W.; Ash, W. W.; Berkelman, K.; Lichtenstein, C. A. (Cornell Univ., Ithaca, N. Y.). Phys. Rev. Lett., 16: 147-50(Jan. 24, 1966).

The interaction $e^- + p \rightarrow e^- + n + \pi^+$ was investigated by detecting e-π coincidences. The kinematic conditions were chosen to maximize the contribution from the exchange of longitudinally polarized photons. The data were compared with the predictions of a theoretical model. It was concluded that the pion charge structure is not very different from that of the proton. (D.C.W.)

9771 PARAMETERS OF THE $K_0\bar{K}_0$ SYSTEM. Eberhard, Philippe H. (Univ. of California, Berkeley). Phys. Rev. Lett., 16: 150-3(Jan. 24, 1966).

The parameters p_S, q_S, p_L, and q_L in the description of the time dependence of a $K_0\bar{K}_0$ mixed state in terms of a short-lived state $|K_S\rangle$ and a long-lived state $|K_L\rangle$ ($|K_S\rangle = p_S|K_0\rangle + q_S|\bar{K}_0\rangle$ and $|K_L\rangle = P_L|K_0\rangle - q_L|\bar{K}_0\rangle$) were studied. (D.C.W.)

9772 EQUAL-TIME COMMUTATORS AND K-MESON DECAYS. Callan, C. G.; Treiman, S. B. (Princeton Univ., N. J.). Phys. Rev. Lett., 16: 153-7(Jan. 24, 1966).

The commutation relations between weak currents are considered using the concept of a partially conserved axial-vector current (PCAC). Equations are derived connecting the form factors that arise in the three leptonic decay modes for mesons (K). Similar relations connect the two leptonic decay modes of mesons (π). The relations involve an off-mass-shell matrix element. The theoretical predictions were compared with on-mass-shell experimental information; the agreement was notable. A simple expression was proposed for the equal-time commutator of axial-vector current and weak, nonleptonic hamiltonian. Together with PCAC, this leads to off-mass-shell relations

between the $K \rightarrow 2\pi$ and $K \rightarrow 3\pi$ modes and to other consequences for the 3π decay. (D.C.W.)

9773 PHOTOPRODUCTION OF THE ETA PARTICLE AT 800–1000 Mev. A COMPARISON BETWEEN THE πN AND THE ηN SYSTEM. Bacci, C. (Univ., Rome); Penso, G.; Salvini, G.; Mencuccini, C.; Silvestrini, V. Phys. Rev. Lett., 16: 157-61(Jan. 24, 1966).

The interaction $\gamma + p \rightarrow \eta + p$ at 0.8 to 1.0 Bev was investigated. The results were compared with results on the interaction $\pi^- + p \rightarrow \eta + n$. The cross sections for pion and eta production in both input channels ($\gamma + N$ and $\pi + N$) were also compared. A coherent picture in the $T = \frac{1}{2}$ isospin state was obtained. It was found that the η-N system is dominated at low energy by a state differing from the known π-N resonances, in good agreement with the proposed S_{11} η-N resonance. (D.C.W.)

9774 PHOTOPRODUCTION OF MESONS AND HYPERONS. Bacher, R. F. (California Inst. of Tech., Pasadena). Phys. Today, 18: 40-52(Nov. 1965).

The development of experimental techniques, especially the availability of high-energy photon beams, and the results of some experimental and analytical studies of photoproduction on hydrogen and deuterium targets, i.e., on protons and neutrons, are reviewed. The determination of positive and neutral pion photoproduction angular distributions, differential cross sections, and total cross sections is discussed at length. Photoproduction of two and three pions, of π-N resonances (N^*), of meson resonances (the η, ρ, and ω), of kaons, and of Σ and Λ hyperons and Y^* resonances is surveyed. (M.J.T.)

9775 CHARACTERISTICS OF π^--NUCLEON COLLISIONS AT A PRIMARY ENERGY OF 4.4 Gev. Malhotra, P. K. (Tata Inst. of Fundamental Research, Bombay). Proc. Indian Acad. Sci., 62: 189-212(Oct. 1965).

Eight hundred sixteen nuclear interactions produced by 4.4 Bev meson (π) in nuclear emulsion were obtained by "along the track" scanning procedure. Favorable secondary particles from a selected 290 π^--N (pion-nucleon) collisions were identified by blob-density and multiple scattering measurements. It is found that the meson (π) often persists in these π^--N collisions, the average persistence is estimated to be 0.24 per collision. It is estimated that π-N and π-π collisions account for 60 and 28% respectively of the secondary particles. The average number of charged shower particles is $\langle n_s \rangle = 2.09 \pm 0.12$, the average number of created charged particles is $\langle n_{c\pm} \rangle = 1.94 \pm 0.12$, the average number of protons with energy greater than 300 Mev is $\langle n_p \rangle = 0.15 \pm 0.05$ and the average number of charged mesons (K) is found to be $\langle n_{k\pm} \rangle = 0.11 \pm 0.06$. The integral energy spectra of mesons (π) in cms as well as in laboratory system are well represented by exponential forms. The average inelasticity of the proton in cms is found to be 0.52 ± 0.10. The charge retention probability for protons in π^--p collisions is 0.45 ± 0.07. (auth)

9776 OBSERVATION OF THE RADIATIVE ELECTRONIC DECAY OF THE PION. Booth, P. S. L.; Carroll, L. J.; Court, G. R.; Johnson, R. G.; Wormald, J. R. (Univ. of Liverpool). Proc. Phys. Soc. (London), 86: 1317-21(Dec. 1965).

A system of spark chambers and scintillation counters was used to observe the structure-dependent part of the radiative electronic decay of the positive pion: $\pi^+ \rightarrow e^+ + \nu + \gamma$. Eleven events were observed with a mean background of 2.6 ± 1.1. The value of the parameter γ as defined by Bludman and Young was found to be either 1.6 ± 0.7 or -3.1 ± 0.7. (auth)

9777 ON THE PHASE-SHIFT ANALYSIS OF THE NUCLEON-NUCLEON SCATTERING ABOVE 1 Gev. Hama, Yogiro; Hoshizaki, Norio (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 34: 584-93(Oct. 1965).

A method for analyzing nucleon-nucleon scattering experiments in the Bev-energy region is proposed. The new scheme is based on an explicit inclusion, in the intermediate-angular-momentum states, of contributions from one-boson-exchange processes and on an assumption that the absorption coefficients can be represented by a smooth function of the orbital angular momentum l, taken as a continuous variable. The phase shifts with higher l are assumed as usual to be represented by OPEC, and those with lower l are determined from the experimental data by the least-squares method. The reliability of the new approach is checked by applying it to an analysis of the p-p scattering data at 970 Mev. The previously found solutions of peripheral- and central-absorption types are obtained again: this fact suggests that the method works well. A discussion on the range of validity of the one-boson-exchange model is given, by which the previously obtained conclusion that its use must be restricted to the region where the impact parameter is larger than some critical value $b_{crit} \sim 0.5\hbar/\mu_\pi c$ is confirmed. (auth)

9778 DISPERSION THEORETIC CALCULATION OF TWO-PION-EXCHANGE CONTRIBUTION IN NUCLEON-NUCLEON SCATTERING. I. FORMULATIONS AND GENERAL RESULTS OF NUMERICAL CALCULATION. Furuichi, Susumu; Watari, Wataro (Rikkyo Univ., Tokyo. Osaka City Univ.). Progr. Theoret. Phys. (Kyoto), 34: 594-631(Oct. 1965).

The two-pion-exchange contribution without pion-pion correlation in nucleon-nucleon scattering is investigated in detail using the partial-wave dispersion relation. With the aim to clarify the contribution the amplitude is divided into the contributions corresponding to the fourth order perturbation (N-part) and the additional effect from the pion-nucleon resonance in the (33) state (33 part), and each part is further divided with respect to the angular momentum of the exchanged two pions, L, so that the characteristics of quantities appearing in the intermediate steps of calculation such as the effective mass distribution functions may be presented in a somewhat concrete way. Through the investigation of the effective mass distribution functions, it is found that (i) the 33 part contributes mostly to the L = 0 and 1 parts, which are the lowest L contributions to $h^{(a)}$ and $h^{(b)}$ respectively, where the whole amplitude is described as $h^{(a)} + \tau^{(1)}\tau^{(2)}h^{(b)}$ for the isospin freedom; (ii) the relative order of magnitude of 33 part to N part shows that the (33) effect is considerably large for L = 0 part at the large effective mass region. This means that the effects of (33) πN resonance in the two-pion-exchange contribution for the nucleon-nucleon scattering have a very similar behavior to the one-scalar-boson exchange contributions, where relatively large effective masses are assumed. Consequently, such features of the 33 part is likely to specify the characteristics of the two-pion-exchange contributions. In fact, the (33) effect is generally very large for lower partial wave amplitudes than the F wave, in the form of "proper" 2π contribution. Comparison with other calculations and discussions of related problems are also given. (auth)

9779 MODELS OF THE π MESON AND ITS COMPOSITENESS. Hayashi, Kenji; Ida, Masakuni; Saegusa, Toshikatsu; Shirafuji, Takeshi; Uehara, Masayuki (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 34: 636-52(Oct. 1965).

The $N\text{-}\bar{N}$ and the ρ-π models of the pion are investigated under the assumption that nearby singularities are essential in the determination of coupling constants by the N/D method or, equivalently, by Green's function method. There are two cases in each model according as whether the pion propagator needs no subtraction or one, which are tentatively called intermediate and composite, respectively, in the present work. A fairly satisfactory agreement with an experimentally given coupling constant is obtained only for the intermediate pion in the ρ-π model, in which an attractive force due to the ω-meson exchange is very important. The result can be remarkably improved if the recently discovered A_1 resonance (~1080 Mev) has the spin-parity 2^-. (auth)

9780 A NOTE ON THE DIFFERENTIAL CROSS SECTION AND THE POLARIZATION OF NUCLEON ELASTICALLY SCATTERED BY DEUTERON. Takemiya, Toshinori (Kumamoto Univ., Japan). Progr. Theoret. Phys. (Kyoto), 34: 700-2(Oct. 1965).

The influences of the D state and the hard core in the

deuteron on the differential cross sections and the polarizations of scattered nucleons are investigated using the impulse approximation for the high energy nucleon-deuteron interaction. The results are compared with experimental data for E_n = 156 Mev. (L.B.S.)

9781 NEUTRINO PHYSICS. Schwartz, M. (Columbia Univ., New York). Rep. Progr. Phys., 28: 61-75(1965).

A review of the status of high-energy neutrino experimentation is given with particular emphasis on the prospects in this field during the next ten years. Current experiments have rather severe limitations, many of which will be removed with the construction of new accelerators and the extensive modification of existing equipment. These programs are discussed in some detail. (auth)

9782 PHOTOPRODUCTION OF SINGLE CHARGED PIONS FROM DEUTERIUM [Thesis]. Sprafka, Robert John. Lafayette, Ind., Purdue Univ., 1965. 95p.

Positive and negative pions, photoproduced from a liquid-deuterium target by the bremsstrahlung beam of the Purdue University electron synchrotron, were detected by a magnetic spectrometer-counter telescope apparatus. Measurements were taken at laboratory angles of 22, 36, 80, and 117° at laboratory pion kinetic energies of 34 and 45 Mev. π^-/π^+ ratios, accurate to 3%, were obtained. Yield curves as a function of peak bremsstrahlung energy were also obtained at several of these angles and energies. Comparisons are made to the dispersion theoretical predictions of Chew, Goldberger, Low, and Nambu, of McKinley, and of Finkler. These theories were evaluated with differing choices for πN scattering phase shift representations, and with different rho meson contributions. It is found that the ρ-γ-π coupling constant determined in this manner is not large enough to significantly affect the dispersion theory results. (Dissertation Abstr.)

9783 THE EFFECT OF TEMPERATURE ON THE FORMATION AND ANNIHILATION OF POSITRONIUM IN POLYMERS [Thesis]. Loper, Gerald Dean Jr. Stillwater, Okla., Oklahoma State Univ., 1964. 89p.

The mean lifetime of positrons against pickoff annihilation from the bound state of positronium in polystyrene, Lucite, and polyethylene (Marlex 50) in the temperature range −196° to +150°C was measured with a "fast-slow" coincidence system containing a transistorized time-to-amplitude converter and a 512-channel data analyzer. Determinations of the intensity of positrons annihilating by this mechanism were carried out from the delayed coincidence curves. The variation of these quantities with temperature was compared to the variation of polymer properties, particularly specific or free volume. Theoretical calculations of lifetimes were made and compared to the experimental results. The lifetime of positrons in graphite from room temperature to 100°C was also measured. The variation of mean lifetime with temperature in polystyrene and Lucite is basically a free volume effect. Positronium is sensitive to second-order transitions that occur in these polymers in the range +70° to +80°C. There is an unexpectedly large change in lifetime in Marlex at −20°C, which may be explained in terms of a possible orientation of the chain molecules. It is uncertain whether the variation of lifetime in this temperature region is entirely due to free volume changes in Marlex. The intensities due to pickoff annihilation in these polymers exhibit a general increase with increasing temperature and free volume. The maximum increase in amount of positronium formed is roughly equal to the increase of free volume over the temperature interval studied. No positronium is formed in graphite up to 100°C. (Dissertation Abstr.)

9784 HIGH ENERGY NEUTRINO REACTIONS AND CONSERVATION HYPOTHESES [Thesis]. Adler, Stephen Louis. Princeton, N. J., Princeton Univ., 1964. 220p.

A number of topics relating to high-energy neutrino reactions and to conservation hypotheses postulated for the strangeness-conserving weak vector and weak axial vector currents are discussed. Chapter I is an introduction and summary. Chapter II is a survey of the field of high-energy weak interactions, with special emphasis on postulated properties of the weak interactions and on tests proposed to test these properties at high energies. Chapter III is a calculation, in terms of certain form factors, of the cross section for the reactions neutrino + nucleon → lepton + baryon, where the final lepton and baryon may be polarized. The most interesting result is that the transverse baryon polarization may be large and is a sensitive function of the form factors. Chapter IV deals with tests of whether the vector current is conserved and whether the axial vector current is partially conserved in high energy neutrino reactions. It was found that in inelastic high energy neutrino reactions, when the lepton mass is neglected and when the lepton emerges with its momentum parallel to that of the incident neutrino, the squared lepton spin averaged matrix element depends only on the divergences of the vector and the axial vector currents. Chapter V is a detailed dispersion-theoretic calculation of single pion production in high energy neutrino reactions, the inelastic weak reaction with the lowest threshold and probably the dominant inelastic weak reaction for neutrino energies of one to several Bev. Chapter VI is a further discussion of the partially-conserved axial vector current hypothesis. New evidence for the partial conservation hypothesis is presented. (Dissertation Abstr.)

9785 RESONANCES IN THE $2\pi^-\pi^+\pi^0$ FINAL STATE COMING FROM $\bar{p}n$ ANNIHILATIONS AT REST. Anninos, P. (Syracuse Univ., N. Y.); Gray, L.; Hagerty, P.; (and others). 13p. (CONF-758-57). ORINS. Gmelin, AED-CONF-65-003-121.

From American Physical Society Meeting, New York, Jan. 1965.

Some results of the reaction $\bar{p}d \rightarrow 2\pi^-\pi^+\pi^0 p$ are presented. The analysis is based on the exposure of a bubble chamber to a beam of antiprotons. About 15,000 three- and four-pronged events in a selected fiducial volume were measured. On the basis of χ^2 criteria, about 5,000 events were classified as the above reaction. These events were examined for resonances decaying into two or three meson (π) states. It is found that there is no significant production of any of the known or unknown resonances for three-meson (π) resonances, and for two-meson (π) resonances there is no evidence of any other resonance except for the meson (ρ^0). (J.F.P.)

9786 PROPOSED TECHNIQUE FOR NEUTRON-PROTON ANGULAR DISTRIBUTION MEASUREMENTS IN THE 15 TO 30 Mev RANGE. Benenson, R. E. (City Coll. of New York, New York. Columbia Univ., New York). 16p. (CONF-650653-7). ORINS. Gmelin, AED-CONF-65-170-24.

From American Physical Society, Summer Meeting, New York.

A system of radiator, magnet field, and high resolution detector is proposed as an approach to high accuracy neutron-proton differential cross section measurements. A single detector serves as an array with an azimuthal angle spread defined by the detector height. Some geometrical considerations of the magnetic field and some practical considerations in the fabrication of the magnet are presented. In addition to neutron-proton scattering, this technique could also find application with either neutrons or charged particle beams for other target materials in solid form as long as the highest particle momenta do not exceed limitations imposed by the magnetic field. (J.F.P.)

9787 π^-p CHARGE-EXCHANGE SCATTERING NEAR 2.0 Gev/c. Carroll, A. S. (Rutherford High Energy Lab., Chilton, Eng.); Corbett, I. F.; Damerell, C. S. J.; Quark, T. W.; Middlemas, N.; Newton, D.; Clegg, A. B.; Williams, W. S. C. 16p. (CONF-650222-1; RPP/H/5). ORINS.

From Royal Society Meeting on Pion-Nucleon Scattering and Excited Nucleon States, London.

A preliminary report is given of an experiment designed to study the reactions $\pi^-p \rightarrow n$ + neutrals → n + Nγ by detecting the gamma rays with thick plate spark chambers. Only the differential cross section for the charge-exchange reaction $\pi^-p \rightarrow \pi^0 n$ is considered. The charge exchange differential cross section was measured at five momenta

centered about the T = ½ resonance at 2.07 Bev/c in the π^-p total cross section. The total cross section measured for π^-p charge-exchange scattering as a function of incident meson (π) momentum is shown. The cross section is at present consistent with a steady fall across the resonance, with no peak. (J.F.P.)

Field Theory, Scattering Theory, and Symmetries

See also Elementary Particles and Radiations

Refer also to abstract 9883.

9788 (ANL-7029, pp 25-7) ANALYSIS OF SCATTERING. Monahan, J. E.; Langsdorf, A. Jr. (Argonne National Lab., Ill.).

Criteria are described that enable an experimenter to select a set of angles at which an angular distribution should be measured in order that the resulting set of measurements should determine the distribution with "minimum uncertainty." Criteria are also given for the selection of measurements that provide "most sensitive" tests of the hypothesis about the degree of distribution. These results are applicable to the measurement of any distribution that can be expressed as a polynomial of finite degree. (M.O.W.)

9789 (CEA-R-2753) POLES DE REGGE ET REPRESENTATION DE MANDELSTAM EN THEORIE DU POTENTIEL [Theses]. (Regge Poles and Mandelstam Representation in Potential Theory [Thesis]). Bessis, Daniel (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1965. 135p. Dep. mn.

Submitted to Paris Univ. (France).

The scattering of two spinless particles interacting through a superposition of Yukawa potentials is analyzed. An upper bound is obtained for the scattering amplitude for complex values of the energy and angular momentum. It is shown that the Regge poles are confined to small domains of the complex angular momentum plane, and the variation of these domains with energy is studied. An upper bound for the double spectral function is derived and is used to show that the Schroedinger equation implies the Mandelstam representation for the type of potentials considered. (D.C.W.)

9790 (IC/65/83) DYNAMICAL GROUP AND MASS SPECTRUM. Boehm, A. (International Centre for Theoretical Physics, Trieste (Italy)). Nov. 1965. 10p. Dep. mn.

A relation between the representation of the Poincaré group and the (4 + 1) de Sitter group is introduced, and it is shown that this relation provides a selection procedure for the mass spectrum which leads to an experimentally correct mass formula. (auth)

9791 (IC/65/91) BROKEN SYMMETRY AND THE SMUSHKEVICH PRINCIPLE. Narayanaswamy, P.; Santhanam, T. S. (International Centre for Theoretical Physics, Trieste (Italy)). Dec. 15, 1965. 13p. Dep. mn.

An attempt is made to incorporate broken SU(2) symmetry of iso-spin into a dynamical scheme based on the Smushkevich principle. It is found that a unique solution to the problem is possible only if conservation of electric charge is assumed, resulting in a simple sum rule for the physical pion-nucleon coupling constants. The possibility of extending this method to higher symmetries is discussed. (auth)

9792 (NYO-3399-43) DIRAC MATRICES AND THE DIRAC MATRIX DESCRIPTION OF LORENTZ TRANSFORMATIONS. Macfarlane, A. J. (Syracuse Univ., N. Y. Dept. of Physics). [1965]. Contract AT(30-1)-3399. 23p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

Dirac matrices and the Dirac-matrix description of Lorentz transformations are discussed. The five anticommuting quantities γ^J (J = 1,2,3,0,5) are treated on an equal footing and recognition of the rule for expressing the three-fold product $\gamma^J\gamma^K\gamma^L$ in terms of one- and two-fold products and of invariant "five-space" tensors g^{JK}, ϵ^{JKLPQ} allows all kinds of multiplication and trace laws for Dirac matrices to be derived systematically. The "five-space" formalism for Dirac matrices affords a very convenient vehicle for the Dirac matrix description of certain de Sitter transformations. By considering the subset of these that leaves the coordinate x^5 invariant, the Dirac matrix description of Lorentz transformations is obtained. Not only does this description give the formula for any Lorentz transformation matrix L in terms of the matrix S, which enters the transformation law of a Dirac spinor $\psi(x)$ under L, but it also gives an explicit inverse formula expressing S in terms of L. (auth)

9793 (NYO-3399-44) SHOULD SU(3) MASS FORMULAS FOR MESONS USE THE MASSES OF THE MESONS OR THEIR SQUARES? Macfarlane, A. J.; Socolow, R. H. (Syracuse Univ., N. Y. Dept. of Physics). Nov. 1965. Contract AT(30-1)-3399. 21p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

The practice of using squares of masses in mass formulas for SU_3 meson multiplets, which arose originally in order to bring the Gell-Mann–Okubo mass formula for the 0^- meson octet more nearly into agreement with experiment, is criticized. The basis of the criticism is that X^0-η mixing can make the Gell-Mann–Okubo formula compatible with the observed 0^- meson spectrum not only when one applies it to the squares of the masses, but also when one applies it to the masses themselves. Of course, the degree of the mixing is different in the two cases and this affects the prediction of decay rates. Accordingly, the decays of 2^+ mesons into two 0^- mesons are discussed in considerable detail as an example of a situation were experimental measurements may discriminate between the values of the mixing angle corresponding to linear and quadratic mass formulas. (auth)

9794 (SLAC-PUB-148) THE W-SPIN RELATIVISTIC VERSION OF SU(6) AND ITS EXPERIMENTAL TESTS. Harari, Haim (Stanford Linear Accelerator Center, Stanford Univ., Calif.). Oct. 1965. Contract AT(04-3)-400. 28p. (CONF-650837-2). Dep. mn. CFSTI $2.00 cy, $0.50 mn.

From Boulder Conference on Particle Physics, Boulder, Colo.

Some of the difficulties encountered in the various versions of "relativistic SU(6)" are discussed with the conclusion that a nontrivial chain of subgroups is obtained, which may serve as a chain of approximate symmetries for some special sets of processes. In particular the group $SU(6)_W$, which has been proposed as a possible underlying symmetry for collinear processes, is studied. Some of its experimental tests are discussed. In most cases a good agreement is obtained between the theoretical predictions and the experimental data. (C.E.S.)

9795 (UCRL-14582-T) GENERAL NON-DYNAMICAL FORMALISM FOR REACTIONS WITH PARTICLES OF ARBITRARY SPIN. NUMBER OF FORM FACTORS. PARITY CONSERVATION. Csonka, Paul L.; Moravcsik, Michael J.; Scadron, Michael D. (Lawrence Radiation Lab., Univ. of California, Livermore). Dec. 1965. Contract W-7405-eng-48. 88p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

The general non-dynamical formalism for reactions involving particles of arbitrary spins is further developed. The number of form factors in the M-matrix is determined under parity conservation as well as other conservation laws, and from this it is derived that many conservation laws have no non-dynamical tests of validity in reactions involving spin-zero particles only. The factorization of the M-matrix into irreducible constituents is developed for parity conserving reactions, and it is shown how the compound observable can be written down in terms of observables and so-called pseudo-observables of the constituent reactions. It is then demonstrated that for parity conserving reactions, an unpolarized and uncorrelated particle is, in general, equivalent to a spin-zero particle possessing both positive and negative parity (dual particle).

The structure of observables in terms of the type of traces they contain is studied. The number of terms in a compound observable is derived. It is also shown that the number of observables in a parity conserving reaction is always larger than the number of independent bilinear combinations of form factors. Thus, there are always linear relations among the observables. The number and character of these relations are explored and it is shown that they also lead to the complete list of parity experiments, i.e., experiments from which one can determine the intrinsic parity of one of the particles in the reaction, knowing the intrinsic parities of the other participating reactions but knowing nothing about the dynamics of the reaction. It is also shown that the observables can be divided into subclasses, a given subclass containing observables which are different linear combinations of the same bilinear combinations of form factors. Each such bilinear combination appears in one and only one subclass. Finally, the set of instructions to calculate observables, given in one of the previous papers for reactions for which only rotation invariance is assumed, is supplemented to take into account the simplifications brought about by the additional assumption of parity conservation. (auth)

9796 UNITARY SYMMETRY AND THE POINCARE GROUP. **Fushchich, V. I. JETP Lett. (USSR) (Engl. Transl.), 2: 99-101(Aug. 15, 1965).**

Conditions are obtained under which an algebra, containing in addition to the generators of the algebras of the Poincare group and the group of internal symmetries (simple Lie group) also additional generators, is a trivial union of the two groups. (J.F.P.)

9797 SUM RULES FOR THE COUPLING CONSTANTS G(B*,BP) IN BROKEN $\tilde{U}(12)$ SYMMETRY. Duc, Dao Vong. JETP Lett. (USSR) (Engl. Transl.), 2: 143-6(Sept. 1, 1965).

Relations are found between the coupling constants of the decays $3/2 \rightarrow 1/2 + 0^-$ in the spurion theory. With each of the relations for the coupling constants the values calculated from previous data for its left and right sides are given. These values are well satisfied by the obtained sum rule. It is also noted that the results include all the relations obtained on the basis of the broken SU(3) symmetry. (J.F.P.)

9798 ELECTROMAGNETIC SPLITTING OF THE MASSES OF THE 70-PLET IN THE SU(6) SYMMETRY SCHEME. **Duc, Dao Vong; Ti, Cao JETP Lett. (USSR) (Engl. Transl.), 2: 163-4(Sept. 15, 1965).**

The electromagnetic mass splitting for the 70-plet of the SU(6) symmetry group is considered. It is assumed that the electromagnetic mass splitting is a second-order effect in the electromagnetic interaction, and that the corresponding hamiltonian is of the form $H_{em} = aQQ + b\tilde{M}\tilde{M}$, where Q and $\tilde{M}$ transform like the charge and magnetic-moment operators, respectively. It is also assumed that the magnetic moments of all possible quarks of which the 70-plet can be made up are the same (J.F.P.)

9799 ELECTROMAGNETIC FORM FACTORS OF BARYONS AND SU(6) SYMMETRY. **Volkov, D. V. (Physico-Technical Inst., Academy of Sciences, Ukrainian SSR). JETP Lett. (USSR) (Engl. Transl.), 2: 181-2 (Sept. 15, 1965).**

An expression is obtained for the vertex describing the interaction of the baryon octet with the electromagnetic field. The breaking of SU(6) symmetry for vertex functions with arbitrary momentum transfer can be formally taken into account by adding to the main SU(6)-symmetry variant additional variants, in which some of the pairs of unit matrices are replaced by γ_5 matrices. It is assumed that the relative weight of the different variants is determined by kinematic factors of the type $[g^2 - (m_1 + m_2)^2]^{1/4}$ for the unit matrix and $[g^2 - (m_1 - m_2)^2]^{1/4}$ for the γ_5 matrix, where m_1 and m_2 are the masses of the baryons whose wave functions frame the matrices I and γ_5. Some consequences of the formula, derived by standard procedure, are noted. (J.F.P.)

9800 PRINCIPLES AND APPLICATIONS OF THE MONTE CARLO METHOD. Rohloff, F. (Kernforschungsanlage, Juelich, Ger.). Kerntechnik, 7: 404-6(Aug.-Sept. 1965). (In German).

The basic principles and derivation of the Monte Carlo method are discussed and illustrated on the calculation of the collision probability in multi-atomic matter. (J.S.R.)

9801 T-INVARIANCE AND THE NEUTRON ELECTRIC DIPOLE MOMENT. **Boulware, D. G. (Harvard Univ., Cambridge, Mass.). Nuovo Cimento (10), 40A: 1041-4(Dec. 21, 1965).**

The results of calculations of the neutron electric dipole moments predicted by various models of CP violation are given. It is concluded that Ramsey's proposed measurement of the electric dipole moment should provide a test for the existence of strangeness conserving CP violating interactions. (auth)

9802 ASYMPTOTIC BEHAVIOR OF THE S-MATRIX AS THE ANGULAR MOMENTUM TENDS TO INFINITY IN THE LEFT HALF-PLANE. **Minerbo, G. N. (Atomic Energy Research Establishment, Harwell, Eng.). Nuovo Cimento (10), 40A: 1055-76(Dec. 21, 1965).**

The behavior of the partial-wave S-matrix as the angular momentum variable tends to infinity in the left half-plane is obtained for nonrelativistic scattering by a Yukawa-type potential. An asymptotic expansion for $S(\lambda,k)$ is given with a simple procedure for obtaining higher-order approximations. (auth)

9803 A GENERAL LITTLE GROUP FOR LORENTZ TRANSFORMATIONS. **Korff, D.; Baker, A.; Fried, Z. (Lowell Technological Inst., Mass.). Nuovo Cimento (10), 40A: 1096-9(Dec. 21, 1965).**

The representations of the proper inhomogeneous Lorentz group are derivable from the little groups of representative four-momenta. It is shown that a general little group may be constructed as a function of a single parameter related to the particle velocity. For different values of this parameter, the usual little groups associated with particles having real mass, zero mass, and imaginary mass are obtained. (auth)

9804 ON THE PRODUCT OF WICK POLYNOMIALS IN THE AXIOMATIC FIELD THEORY. **Boehm, A.; Polivanov, M. (International Atomic Energy Agency, Trieste). Nuovo Cimento (10), 40A: 1110-19(Dec. 21, 1965).**

A provisional definition of the product of Wick polynomial expansion of operators in axiomatic field theory is suggested. This definition is applied for the computation of the asymptotic forms of the currents in the model of quantum electrodynamics, which are shown to agree with the expressions of the renormalized canonical theory. (auth)

9805 A DISPERSION THEORY OF SYMMETRY BREAKING. **Fubini, S. (Univ. Torino, Italy. CERN, Geneva); Furlan, G.; Rossetti, C. Nuovo Cimento (10), 40A: 1171-93(Dec. 21, 1965).**

A new relativistic approach to the problem of broken symmetries is proposed. This is the covariant generalization of the nonrelativistic sum rules obtained in previous investigations. The result is in the form of dispersion sum rules where the pole term represents the group-theoretical answer and the cut the breaking correction. The method is applied to SU_3 and chiral $SU_3 \times SU_3$ leading to very satisfactory results and predictions. (auth)

9806 SOME SIMPLE SUM RULES IN POTENTIAL SCATTERING. **Chadan, K. (Laboratoire de Physique Theorique, Orsay, France). Nuovo Cimento (10), 40A: 1194-1205(Dec. 21, 1965).**

Some sum rules are derived for the nonrelativistic scattering of particles in a given angular-momentum state by a central potential of finite radius. They relate the derivative of the phase shift to the integral, over the whole energy range, of a simple expression of the phase shift. If bound states are present, they contribute to the r.h.s. by simple expressions. These sum rules are such that, by integrating over a finite energy range, inequalities are automatically obtained which are, in some respect, similar to those of Wigner and may have similar applica-

tions in low-energy scattering of elementary particles. For instance, if the phase shift and the energy of the possible bound states are known the radius of the interaction can be easily calculated. (auth)

9807 COMPOSITENESS AND VANISHING OF RENORMALIZATION CONSTANTS. Kaschluhn, F. (Humboldt-Univ., Berlin). Nuovo Cimento (10), 40A: 1216-19 (Dec. 21, 1965).

The equivalence for treating bound states within the N/D framework and the vanishing of the vertex renormalization constant Z_1 are studied for the case of scalar particles within the elastic approximation assuming Levinson's theorem. The s-wave scattering amplitude A(s) is considered, and expressions for Z_1 are obtained and evaluated for the elementary-particle and bound-state cases. (M.J.T.)

9808 ON THE AXIOMATIC TREATMENT OF THE LEE MODEL. Clausen, H.; Urban, P. (Univ., Graz). Oesterr. Akad. Wiss., Math.-Naturwiss. Kl., Anz., 101: 41-55(1964). (In German).

It was shown that the LSZ formalism is applicable to the Lee model and, in spite of the fact that two axioms are not fulfilled, leads to the usual results. (tr-auth)

9809 A USEFUL RELATION AMONG CASIMIR OPERATORS. Resnikoff, M. (Univ. of Maryland, College Park). Phys. Lett., 19: 596-7(Dec. 15, 1965).

Mass formulas for SU(6) have necessitated a knowledge of the quadratic Casimir operators C_2 on a representation of the subgroups SU(2), SU(3), and SU(4). The new extension of group theoretical methods, the dynamical groups, now require a knowledge of the Casimir operators C_p for the group SU(n). A rather simple method of obtaining these numbers for the group SU(n), in general, is pointed out. (J.F.P.)

9810 HIGH ENERGY BEHAVIOUR OF SCATTERING AMPLITUDES AND CROSS SECTIONS USING CROSSING SYMMETRY AND HOLOMORPHY IN TWO VARIABLES. Eden, R. J. (Univ. of Maryland, College Park). Phys. Lett., 19: 695-6(Jan. 1, 1966).

A method is presented for studing the high energy behavior of scattering amplitudes in which smooth functions that involve powers of E or of log E are used. It is shown how the results from crossing and analyticity in E can be combined with holomorphy in the variable t and temperedness in E within the domain of holomorphy. (L.B.S.)

9811 SUM RULE FOR THE ISOVECTOR MAGNETIC MOMENT OF THE NUCLEON. Cabibbo, N. (CERN, Geneva); Radicati, L. A. Phys. Lett., 19: 697-9(Jan. 1, 1966).

An exact sum rule is obtained for the isovector magnetic moment of the nucleon from the commutation relations of the electric dipole moment operators. (L.B.S.)

9812 REMARK CONCERNING THE BASIC SU(3) TRIPLETS. Klein, O. (Brandeis Univ., Waltham, Mass.). Phys. Rev. Lett., 16: 63-4(Jan. 10, 1966).

It was previously shown that the replacement of the quarks or aces, proposed by Gell-Mann and Zweig as the basic triplets for the SU(3) representation of baryons, by two different integer-charge triplets implies the appearance of a quantum number (super-charge) in addition to spin, isospin, hypercharge and baryon number. This "super-charge" was re-defined in terms of baryon and lepton number, and strangeness, retaining the original Gell-Mann-Nishijina formula by re-defining the fermion number as the difference between the baryon and lepton number. (G.O.Y.)

9813 QUARK MODEL FOR FORWARD SCATTERING AMPLITUDES. Lipkin, H. J.; Scheck, F. (Weizmann Inst. of Science, Rehovoth, Israel). Phys. Rev. Lett., 16: 71-5(Jan. 10, 1966).

On the basis of the assumption that the forward scattering amplitude for any interaction is simply the sum of all possible contributing two-body quark-quark or quark-antiquark scattering amplitudes, relations between baryon-baryon and baryon-meson forward scattering amplitudes were derived, together with relations for baryon-meson scattering which can also be obtained from higher symmetries. (D.C.W.)

9814 RATIO OF THE WAVE-FUNCTION RENORMALIZATION CONSTANTS. Khuri, N. N. (Rockefeller Univ., New York). Phys. Rev. Lett., 16: 75-8(Jan. 10, 1966).

The ratio of the wave function renormalization constants of the kaon and the pion was derived by applying the Fubini-Furlan method to the equal-time canonical commutation relations for the renormalized kaon and pion fields. It is noted that the same procedure can be applied to spin-$\frac{1}{2}$ particles. (D.C.W.)

9815 SU(6) RESULTS DERIVED FROM CHIRAL SU(3) ⊗ SU(3) ALGEBRA. Gerstein, Ira S. (Univ. of Pennsylvania, Philadelphia). Phys. Rev. Lett., 16: 114-17 (Jan. 17, 1966).

The results previously obtained from SU(6) symmetry are derived by assuming that the matrix elements of the chiral SU(3) ⊗ SU(3) algebra evaluated between one-particle states moving at high velocity are saturated by one-particle, octet-baryon and decuplet-resonance states. (G.O.Y.)

9816 GENERALIZED EHRENFEST THEOREM. Lippmann, B. A. (Defense Research Corp., Santa Barbara, Calif.). Phys. Rev. Lett., 16: 135-8(Jan. 24, 1966).

The generalized Ehrenfest theorem, which essentially derives a sum rule for the process considered, was applied to a collision process involving N channels. (G.O.Y.)

9817 A DYNAMICAL MODEL OF THE SU(3)-SYMMETRY VIOLATION. Kunimasa, Tosaku (Osaka Univ.). Progr. Theoret. Phys. (Kyoto), 34: 632-5(Oct. 1965).

A model of the SU(3)-symmetry violation is proposed based on the parafermion quark model, and also a paraboson θ with baryon number $\frac{2}{3}$, charge $\frac{1}{3}$, and hypercharge $\frac{2}{3}$ is introduced. The symmetry violating interaction is assumed to be trilinear in the paraboson θ and quarks. The D-type mass difference of the baryon octet is shown to result from the pair correlation of quarks in the baryon. Schwinger's sum rule for vector mesons and a new one for pseudoscalar mesons $(m_\eta^2 + m_\pi^2 + m_K^2)(4m_K^2 - m_\pi^2) = 6m_K^4 + 3m_\eta^2 m_\chi^2$, which is in good agreement with the experiments, are obtained with some further assumptions. (auth)

9818 BOOTSTRAP MECHANISM AND NON-LEPTONIC WEAK INTERACTIONS. Yamada, Masao (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto), 34: 653-73(Oct. 1965).

Nonleptonic weak interactions are discussed from the standpoint of the bootstrap mechanism, under the assumption that the multiplicities of baryons and pseudoscalar mesons are smaller than eight. By analyzing baryon-pseudoscalar meson scattering amplitudes of the non-zero ΔI, ΔU and ΔP processes, it is shown that the only one consistent symmetry with the bootstrap mechanism is restricted to the global symmetry. And, consequently, the parity conserving part of the non-leptonic weak interactions has the properties of $\Delta I = \frac{1}{2}$ and $\Delta U = 1$. The parity-changing part is also discussed. The selection rules are also derivable for this part as a result of the assumption that baryons are self-consistent bound states of themselves with π mesons. Further the resulting weak interactions are such that $\Sigma^+ \to N + \pi^+$ is a pure p wave, while $\Sigma^- \to N + \pi^-$ is a pure s wave. (auth)

9819 THE PSEUDOPOTENTIAL FOR THE HARD-CORE INTERACTION. Sunakawa, Sigenobu; Fukui, Yoshihiko (Tohoku Univ., Sendai, Japan). Progr. Theoret. Phys. (Kyoto), 34: 693-5(Oct. 1965).

An exact pseudopotential is proposed for the treatment of a system with hard-core interaction, where the conventional perturbation method cannot be applied, and which is independent of the incident energy. The pseudopotential is applicable even to the case of scattering with weak interaction outside the core which is not spherical. An example is given of scattering by a reflecting plane at $x = 0$, when the hard core lies in the region $x > 0$. (L.B.S.)

9820 A MODEL OF DYNAMICAL MASS SPLITTING. I. Katsumori, Hiroshi (Institut Henri Poincare, Paris). Progr. Theoret. Phys. (Kyoto), 34: 696-8(Oct. 1965).

A model for the baryon-meson system is proposed in order to study dynamically the mass splitting arising from the unifying algebra. As an example the octet $\frac{1}{2}^+$ baryon-octet 0^- meson system is considered. (L.B.S.)

9821 A MODEL OF DYNAMICAL MASS SPLITTING. II. Katsumori, Hiroshi (Institut Henri Poincare, Paris). Progr. Theoret. Phys. (Kyoto), 34: 698-700(Oct. 1965).

A model for the baryon-meson mass splitting is applied to the decuplet $\frac{3}{2}^+$ baryon-octet 0^- meson system. (L.B.S.)

9822 WEAK RADIATIVE DECAY OF HYPERONS AND $\tilde{U}(12)$ SYMMETRY. Toda, Azuma (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto), 34: 702-4(Oct. 1965).

The decay amplitudes of the weak radiative decay modes of hyperons are discussed under the assumption of the $\tilde{U}(12)$-symmetry scheme. Relations among the matrix elements are obtained. (L.B.S.)

9823 UNITARY GROUPS: REPRESENTATIONS AND DECOMPOSITIONS. Itzykson, C. (Stanford Univ., Calif.); Nauenberg, M. Rev. Mod. Phys., 38: 95-120(Jan. 1966).

An elementary account is given of the representation theory for unitary groups. The basic definitions and the construction of irreducible representations using tensor methods are reviewed, and the connection to the infinitesimal approach is indicated. Special attention is given to the detailed procedure to obtain Clebsch–Gordan series and to the problem of finding the (SU_m, SU_n) content of an irreducible representation of SU_{mn} or SU_{m+n}. The properties of the Young operators used in constructing the tensor representations are summarized, providing the link with the representation theory of the symmetric groups. A tabulation of various decompositions and of Weyl's dimension formula for tensor representation, is included. (auth)

9824 GENERAL MONTE CARLO MULTIVERTEX EVENT GENERATOR. Bordner, C. A. Jr.; Brenner, A. E.; Ronat, E. E. (Harvard Univ., Cambridge, Mass.). Rev. Sci. Instrum., 37: 36-43(Jan. 1966).

A self-contained easily expanded Monte Carlo program for the study of interactions in high energy physics is described. The program is capable of generating events and plotting results for a very wide class of reactions, including those governed by Lorentz invariant phase space and, also, those exhibiting resonances or other nontrivial matrix elements. The performance of the basic program and the method of extending its scope are demonstrated in two examples showing the required input and resulting output. (auth)

9825 VIOLATIONS OF SYMMETRY IN PHYSICS. Wigner, Eugene P. Sci. Amer., 213: 28-36(Dec. 1965).

The various hypotheses invented to describe symmetries in the laws of nature, particularly the C, P, CP, and T mirrors, are discussed with respect to β decay in a magnetic field and charged-particle scattering on a heavy nucleus. The experiment by C. S. Wu and collaborators demonstrating the anisotropy of β decay in a magnetic field and the Cronin-Fitch experiment showing the violation of CP invariance in $K_2^0 \rightarrow 2\pi$ decay are explained. The possibility that the only symmetry remaining valid is the CPT symmetry is considered. (M.J.T.)

9826 A MODEL FOR ELEMENTARY PARTICLES SATISFYING THE SU(6) SYMMETRY. Hu, Ning; Guan, Hung (Peking Univ.). Sci. Sinica (Peking), 14: 1525-8 (Oct. 1965).

It is proposed that the spin-independent interaction among the quarks are one order of magnitude greater than the usual strong interactions. On account of parity conservation, the super-strong interaction cannot exist in the form of Yukawa interactions of the pseudoscalar (0^-) and vector (1^-) mesons with the $\frac{1}{2}^+$ and $\frac{3}{2}^+$ baryons. It is shown that these particles are probably the only composite particles formed directly from the quarks, and that other particles such as the 0^+ mesons may be considered as composite particles formed by the usual strong interactions. (L.B.S.)

9827 ON THE INTRINSIC ENERGY INTEGRAL, BARE MASS AND ELECTRON PROPAGATOR IN QUANTUM ELECTRODYNAMICS. Pevzner, M. Sh. (Dnepropetrovsk Inst. of Mining, USSR). Ukr. Fiz. Zh., 10: 910-11(Sept. 1965). (In Ukrainian).

The intrinsic energy integral of electrons and analytical properties of the electron propagator were examined, following up the studies of K. Johnson et al. (Phys. Rev. Lett. 11, No. 11 518(1963)), in which it was confirmed that the integral is finite, as long as its bare mass is zero. On the basis of Dyson's equation it can be shown that the specific expressions of the higher operator and of the photon propagator are replaced by asymptotic values at high pulses. Using the method developed by S. Edwards (Phys. Rev. 90, 284(1953)) a differential equation was derived; however, it cannot be integrated directly. It was shown that if the bare mass is equal to zero, the requirement that the intrinsic energy be finite is fulfilled. The analytical properties of the electron propagator were examined by means of an auxiliary function. (TTT)

9828 ASYMPTOTIC BEHAVIOR OF SCATTERING AMPLITUDE AND HIGH ENERGY INELASTIC PROCESSES. Kwo, She-hung (Chungsan Univ., China). Wu Li Hsueh Pao, 21: 1689-96(Sept. 1965). (In Chinese).

Assuming that the vacuum Regge poles become a complex conjugate pair when $t < 0$, the elastic part of the high energy unitary integral was calculated. The result shows that there should also be a series of branch points. By the elastic part of the integral, it is impossible to obtain the terms corresponding to other Regge poles. When the Regge representation is applied to high energy inelastic interactions according to the fireball model, it is shown that the cross section for a finite number of fireballs falls with $(\ln s)^{-3}$. In order that the total cross sections approach constant values, the number of fireballs should increase with $\ln s$. (auth)

9829 SPONTANEOUS SYMMETRY BREAKDOWN IN A MODEL OF ELEMENTARY PARTICLES WITH SU(3) ⊗ SU(3) SYMMETRY [Thesis]. Byrne, Richard Nelson. Stanford, Calif., Stanford Univ., 1965. 133p.

The Nambu-Jona-Lasinio model of elementary particles was extended to include the symmetry SU(3) ⊗ SU(3). The technique used to determine four-field couplings invariant under this symmetry is illustrated for the simpler symmetry SU(2) ⊗ SU(2). A new method of deriving the self-consistent baryon mass equation is used. It is assumed that the solutions are diagonal in hypercharge and the Z-component of isotopic spin, and that they are degenerate in the Z-component of isotopic spin. The model predicts $M_\Sigma = M_\Lambda$, and the spectrum of masses is exhibited and compared with experiment. The various Goldstone bosons in the theory are exhibited, and the method of computing baryon-antibaryon scattering is illustrated using the SU(2) ⊗ SU(2) symmetric model. (Dissertation Abstr.)

9830 RELATIVISTIC FORMULATION OF THE LIFE-TIME MATRIX IN COLLISION THEORY [Thesis]. Glen, Tran Trong. Athens, Ohio, Ohio Univ., 1965. 187p.

The lifetime of a collision is usually considered as the delay time of a wave-packet effected by a scattering potential. The lifetime matrix was formulated corresponding to the Dirac and Klein-Gordon equations. The suitable forms of the lifetime matrices were proposed and shown to correspond to the lifetime calculated in the wave-packet analysis for these cases. The relation between the lifetime matrix Q and the scattering matrix S was found. Related topics such as the lower bound of the delay time, the transformation properties of the Q matrix, the relationship between the lifetime and the observable decay lifetime were also investigated or discussed. (A.G.W.)

9831 BOOTSTRAPS FOR MESON–BARYON SYSTEMS [Thesis]. Gyuk, Imre Paul. Lafayette, Ind., Purdue Univ., 1965. 57p.

Meson-baryon systems are considered as consisting of one baryon and one meson, interchange of a baryon or baryon resonance providing the attractive force. The various (M,B) systems are analyzed by using the crossing matrix. A number of bootstrap families is found: $N_{\frac{1}{2},L-\frac{1}{2}} \rightleftharpoons N_{\frac{1}{2},L+\frac{1}{2}}$, $\Lambda_{0,L-\frac{1}{2}} \rightleftharpoons \Sigma_{1,L-\frac{1}{2}}$, $\Sigma_{1,L-\frac{1}{2}} \rightleftharpoons \Sigma_{1,L+\frac{1}{2}}$, where $L \geq 1$ is the angular momentum of the system. These families for L =

1,2,3, are seen to fill up almost all of the observed N* and Y* resonances. Furthermore the decays are also given correctly. The dispersion theoretic tools for more detailed, quantitative calculations are developed. The N/D equation is solved in an approximate form for the N-N* and Σ-Y_1^* bootstraps. Then a fully selfconsistent calculation following Diu and Rubinstein is presented for the N-N* case. It is found that one cannot obtain a true solution, but an approximate result for the ratio of the coupling constants and for the mass separation is yielded. (Dissertation Abstr.)

9832 MODIFIED EFFECTIVE RANGE THEORY EXPANSIONS FOR LONG RANGE EFFECTIVE POTENTIALS [Thesis]. Berger, Rosalind Oppenheim. New York, New York Univ., 1965. 96p.

The effective one-body potential representing a particle-compound system interaction usually has a very complicated short-range behavior but a relatively simple and more or less known long-range tail, U, which can be nonlocal and energy-dependent. With U present, the usual effective range theory (ERT) expansion for a single-channel scattering phase shift η is inapplicable. Recent extensions of ERT include the effects of long-range potentials, but since η then becomes very energy dependent, one would need many terms to obtain the desired accuracy, so that the results are of restricted use. It is shown that one can first solve, numerically, a one-body problem that includes only U, and then use a modified ERT expansion for the difference, δ, between η and the phase shift due to U alone. Two such modified ERT expansions are derived, one for long-range potentials, U, which fall off faster than $1/r^3$, and the other for these potentials in the presence of a Coulomb field. The technique used to derive the expansions is modeled on the technique used to derive the usual ERT expansion, which holds for phase shifts relative to pure Coulomb scattering. Since, by using the modified ERT expansions that hold when U is present, the rapid energy dependence due to U is extracted out (exactly), terms in the expansion that depend upon the short-range potential in the presence of U are more slowly varying in energy; they involve a number of adjustable parameters to be determined experimentally, but only a few are usually needed. The procedure thus makes possible the extrapolation of low-energy scattering data down to zero energy, even when effective long range potentials are present. (Dissertation Abstr.)

9833 STATUS OF SU(6); A SURVEY. Lee, Benjamin W. (Inst. for Advanced Study, Princeton, N. J. Univ. of Pennsylvania, Philadelphia). 10p. (CONF-650653-8). ORINS. Gmelin, AED-CONF-65-170-21.

From American Physical Society, Summer Meeting, New York.

In the summary of SU(6) it is postulated that the most successful results can be derived from a non-relativistic model in which baryons and mesons are made up of three quarks and a pair consisting of a quark and an antiquark, respectively, and the interactions between the quarks and antiquarks are spin and unitary spin independent. The antisymmetrization of quarks is neglected in order to expedite the discussion. An abstract group theoretical structure isomorphic to that deduced from this model is considered. An understanding of how such a group theoretical structure can arise in relativistic particle physics is also considered. (J.F.P.)

Fluid Physics and Thermodynamics

See also Plasma Physics and Thermonuclear Processes

9834 (AFCRL-65-706) HYDROMAGNETIC IONIZING WAVES. Physical Physics Research Papers No. 146. Rubin, Allen G.; Kushwaha, Ram S. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.). Aug. 20, 1965. 24p. CFSTI $1.00 cy, $0.50 mn.

A theory of hydromagnetic ionizing waves was developed which is valid in the region in which gas pressure is negligible, compared with magnetic pressure. The theory takes into account the energy expended in partial ionization of the gas behind the wave. The usual high conductivity boundary condition behind the wave is not employed. The electric field in front of the wave is taken as a parameter. Results of this theory are compared with available experimental measurements, and show good agreement. (auth)

9835 (LA-3407) A STUDY OF TRUNCATION ERRORS IN EULERIAN HYDRODYNAMICS. Longley, H. J. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). Sept. 1965. Contract W-7405-eng-36. 28p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

A numerical and analytical study is given of the effects of truncation errors for various differencing schemes in Eulerian hydrodynamics. Space truncation errors are studied for a conventional second order time scheme. Correlations can be made between the analytical theory and the numerical calculations. (auth)

9836 (NP-15665) PATH INTEGRAL CALCULATION OF THE TWO-PARTICLE SLATER SUM FOR He_4. Report No. 186. Fosdick, Lloyd D.; Jordan, Harry F. (Illinois Univ., Urbana. Dept. of Computer Science). Aug. 20, 1965. 42p.

The Wiener integral formulation combined with Monte Carlo sampling was used to compute the two-particle Slater sum for ^{4}He for temperatures ranging from 273 down to 2°K, the lower practical limit for this computational method. This is equivalent to a calculation of the density independent part of the pair distribution function. A Lennard-Jones 6-12 potential was used to describe the interaction. Contributions from exchange were found negligible at 5°K and above. Comparisons with the Wigner-Kirkwood expansion are made. The second virial coefficients derived from these results are within two percent or three percent of the results obtained from the usual phase shift calculation. (auth)

9837 (UCRL-14399) A COVARIANT FORM OF CONTINUUM MECHANICS AND THERMODYNAMICS. Neuman, M. (Lawrence Radiation Lab., Univ. of California, Livermore). Aug. 25, 1965. Contract W-7405-eng-48. 36p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Continuum mechanics and thermodynamics are presented in a form independent of coordinate frames and their condition of motion. With respect to the absence of reference to inertial frames the representation resembles that of Maxwell's equations for the electromagnetic and Einstein's for the gravitational field rather than the usual mechanical theories. The basic dynamical variables are the metric tensor, the differential circulation (rather than momentum), and entropy. From this general form the usual Euler, Lagrange, and noninertial laboratory representations may be obtained through specialization. (auth)

9838 STUDY OF THE TRANSPORT EQUATION IN AN IMPURE FERMI LIQUID. Betbeder-Matibet, Odile (Ecole Normale Superieure, Paris). Ann. Inst. Henri Poincare, 2: 171-260(1965). (In French).

The Landau transport equation for quasiparticles in a Fermi liquid is derived for the case in which the particles of the system undergo collisions with static impurities. The Green's function formalism is used, and the effect of collisions on the singularities of propagators is investigated. (D.C.W.)

9839 THE FLOW OF LIQUID HELIUM II THROUGH A NARROW CHANNEL. Keller, W. E.; Hammel, E. F. Cryogenics, 5: 245-7(Oct. 1965). (LADC-7236).

The production and effect of a temperature difference between the ends of the channel is considered. The flow of liquid helium II driven by a gravitational head through a narrow channel has usually been considered to be an isothermal process. However, in most experimental arrangements, small temperature differences between the ends of the channel develop during the flow. It is shown that when these differences are not taken into account, incorrect conclusions concerning the critical velocity and the dissipation function may result. An example is given indicating how these temperature differences may be mea-

sured and what corresponding corrections are required in order that meaningful information about the flow process can be derived from the observations. (auth)

9840 EXISTENCE OF THE H_5^+ ION IN A POSITIVE COLUMN OF A HYDROGEN GLOW DISCHARGE AT HIGH PRESSURE. Starodubtsev, S. V. (Inst. of Nuclear Physics, Academy of Sciences, USSR); Knopov, V. M.; Pozharov, S. L.; Chrnov, I. G. Dokl. Akad. Nauk SSSR, 163: 155-6(July 1, 1965). (In Russian).

In connection with the recent, surprising discovery of the ion cluster H_5^+ in a negative column of a hydrogen glow discharge at a pressure of 0.25 mm Hg (P. H. Dawson, A. W. Tickner, J. Chem. Phys. 37: 672(1962)), an attempt was made to find out whether this ion cluster also exists in a positive column of glow discharge in hydrogen at higher pressures (1–10 mm Hg). The ions were taken from the plasma along the discharge axis through a 72 μ diameter aperture in the anode. Along with the ions H_1^+, H_2^+, and H_3^+, the ion with the mass number 5, whose current intensity with respect to that of the H_3^+ ions was 0.65%, which is five times as high as that measured by Dawson and Tickner was discovered. The high sensitivity of the apparatus used, as well as the relatively high intensity of the ion current extracted from the plasma ($\sim 4 \times 10^{-8}$ amp) made it possible to determine the relative current intensity of the H_5^+ ions with sufficient accuracy as a function of pressure and current of the discharge. Mechanisms for production of the H_5^+ ion are discussed. (TCO)

9841 EXPERIMENTAL STUDY OF TURBULENT FLOW OF AN ELECTROCONDUCTIVE FLUID IN A PIPE IN A LONGITUDINAL MAGNETIC FIELD. Kovner, D. S.; Krasil'nikov, E. Yu. (Moscow Aviation Inst.). Dokl. Akad. Nauk SSSR, 163: 1096-9(Aug. 11, 1965).

A study was conducted on the characteristics of turbulent flow of an electroconductive fluid in a pipe with the presence of a magnetic field whose induction vector is parallel to the flow velocity. The experiments featured the use of a liquid-metal gallium loop. The loop contained an electromagnetic direct current conduction pump, a Venturi flowmeter, a cooler, and a working mechanism. The working mechanism was composed of pipes of seamless nonmagnetic steel with inner diameters 9.8 and 5.2 mm. The conduction of the steel is about $\frac{1}{3}$ that of the gallium. Additional instrumentation was provided for measurement of static pressure. A description of the generation of the magnetic field is given. The study was undertaken to determine the coefficient of hydraulic friction according to the formula $\lambda = -2d(dP/dx)/\rho U_{cp}^2$ where the pressure gradient dP/dx is obtained from readings taken at 0.5-meter intervals along the length of the pipe. Values of friction were determined experimentally and compared with values obtained with the use of various formulas. The data are plotted against values of Reynolds number and Hartmann's number. It is concluded that the formula $\lambda = 0{,}3164R^{-0{,}25}(1-37{,}7H^{1{,}65}/R^{1{,}45})$ is a good approximation of the resistance under the experimental conditions. (ATD)

9842 MAGNETOHYDRODYNAMIC FLOW IN AN ANNULAR CHANNEL IN THE PRESENCE OF A UNIFORM MAGNETIC FIELD. Erdogan, Emin (Technical Univ. of Istanbul). Istanbul Tek. Univ. Bul., 18: 37-43(1965).

An investigation is made of the laminar steady-state flow of an incompressible, viscous, electrically conducting fluid through an annular channel in the presence of a uniform transverse magnetic field. An exact solution is obtained; thus it is valid for all values of the Hartmann number. The solution gives the solution of the magnetohydrodynamic pipe flow in the case where the inner cylinder radius vanishes. Furthermore, the classical nonconducting result is obtained. (auth)

9843 MAGNETOHYDRODYNAMIC FLOW IN RECTANGULAR DUCTS. II. Hunt, J. C. R. (Central Electricity Research Labs., Leatherhead, Eng.); Stewartson, K. J. Fluid Mech., 23: 563-81(1965).

A previous discussion on laminar motion of a conducting liquid in a rectangular duct under a uniform transverse magnetic field is extended. The effects of the duct having conducting walls are further explored; in this case the duct considered has perfectly conducting walls parallel to the field and non-conducting walls perpendicular to the field. A solution is obtained for high Hartmann numbers by analyzing the boundary layers on the walls. This solution involves an integral equation of a standard form. It is found that in this case the velocity profiles in the boundary layers are monotonically decreasing. The effect of an external electrical circuit is examined, although it is found that it does not influence the form of the velocity profiles. (auth)

9844 OBSERVATIONS OF FOCUSING EFFECTS ON AN INTENSE LUMINOUS BEAM IN A GAS. Breton, C.; Capet, M.; Chalmeton, V.; Nguyen Quang, D.; Papoular, R. (EURATOM-CEA, Fontenay-aux-Roses, France). J. Phys. (Paris), 26: 490-3(Aug.-Sept. 1965). (In French).

Light-induced discharges were studied by time resolved spectroscopy and photography. Experiments were performed in nitrogen at pressures between 1 and 25 atmospheres, with a neodymium-doped glass laser (1.06 μ, 30 Mw). The emitted spectrum starting shortly before the breakdown and increasing during the laser pulse is a continuum covering the near uv and visible regions. Its shape does not depend noticeably upon the pressure or the beam intensity. (auth)

9845 STUDY OF ION BEAMS IN PRESENCE OF A UNIFORM MAGNETIC FIELD. Perulli, M.; Etievant, C.; Lutaud, E. (EURATOM-CEA, Fontenay-aux-Roses, France). J. Phys. (Paris), 26: 493-6(Aug.-Sept. 1965). (In French).

The mechanisms of interaction of a neutralized beam of ions and also of two symmetric neutralized ion beams flowing parallel to a magnetic field, are described. The dispersion relation for obliquely propagating electrostatic waves is considered in relation to the following topics: a beam of cold ions neutralized by cold electrons at rest, influence of a cold plasma, role of the electron term, expression of the relations previously obtained, allowing for a transverse thermal velocity, the case of two symmetric ion beams, neutralized by electrons at rest. Results obtained in the EOS experiment, which was set up to study these interactions for the following cases: one beam; two symmetric beams, are presented. (auth)

9846 GENERATION OF HARMONICS IN A DOUBLE-BEAM SYSTEM IN PRESENCE OF A MAGNETIC FIELD. Olivain, J.; Etievant, C.; Perulli, M. (EURATOM-CEA, Fontenay-aux-Roses, France). J. Phys. (Paris), 26: 505-7 (Aug.-Sept. 1965). (In French).

The h-f oscillations generated by a symmetric system of two counter-streaming beams in the presence of a magnetic field, were studied. They consist of a spectrum of harmonics of half the electron gyromagnetic frequency and a spectrum related to the electron transit time. (auth)

9847 SPATIAL DISTRIBUTION OF A HIGH-FREQUENCY ELECTRIC FIELD IN A RESONANT DISCHARGE. Brunet, A.; Taillet, J. (CEN, Saclay, France). J. Phys. (Paris), 26: 517-19(Aug.-Sept. 1965). (In French).

Using an electron-beam probing technique, the internal electric field in a r-f discharge was measured. Comparison with a simple theoretical model shows that the steady state of a large class of r-f discharges is controlled by a plasma-sheath resonance. (auth)

9848 HEAT TRANSFER MODELING IN IONIZED GASES IN PRESENCE OF ELECTROMAGNETIC FIELD. Blums, E. (Inst. of Power Engineering, Academy of Sciences, Latvian SSR). Latv. PSR Zinat. Akad. Vestis, Fiz. Tek. Zinat. Ser., No. 4, 18-27(1965). (In Russian).

A theoretical analysis is performed to determine the heat-transfer similarity conditions in a magnetohydrodynamic flow. The possibilities of modeling the heat-transfer in ionized gases by using electroconducting liquids are shown. Electrolytic solution was found to be applicable to heat-transfer modeling in low-ionized gases, whereas liquid metal was found to be more appropriate in cases of high temperature. (auth)

9849 LINEARIZED PROBLEM ON THE SUPERSONIC FLOW AT THE ENTRANCE OF A MAGNETOHYDRODYNAMIC CHANNEL ELECTRODE ZONE. Barmin, A. A.;

Kulikovskii, A. G.; Lobanov, L. F. Prikl. Mat. Mekh., 29: 609-15(July-Aug. 1965). (In Russian).

The effect of the electromagnetic field on the supersonic flow of the gas is shown. Since the parameters of interaction and the Reynolds magnetic number were small, the problem was examined in the linearized conditions and the magnetic field was calculated along the channel. (tr-auth)

9850 ANALYTICAL AND EXPERIMENTAL STUDY OF THE TRANSIENT BASE PRESSURES RESULTING WHEN AN AXI-SYMMETRIC SUPERSONIC MISSILE FLIES HEAD-ON THROUGH A BLAST WAVE [Thesis]. Tang, Homer Ho. Stillwater, Okla., Oklahoma State Univ., 1964. 115p.

When a supersonic missile passes through a strong blast wave such as that created by a nuclear explosion, the low-pressure air trapped at the base of the missile acts as a cushion for the pressure rise. As the blast overpressure decays, a transient base pressure results which is an interaction of the instantaneous airstream conditions and the time-history of the jet mixing process at the base. The problem is thus divided into two parts: blast wave passage and post-passage transients. The relation of base pressure versus time was sought by analytical means. A flow model was devised for the conditions before and after the blast front passage over a slender axisymmetric missile. A solution was obtained by a transformation to a wave-attached coordinate system. For the transient conditions following the blast front, a quasi-steady approach was adopted, using time iteration. To do so, it was necessary to extend Zumwalt's conical wake method for steady flow to include mass transfer from the airstream to the separated air at the base. A wind tunnel test program was designed and data were analyzed to obtain empirical information required for effective conical jet pumping surface. These tests included both steady-state and transient base pressures. An analysis resulted, which is experimentally verified for simple base pressure transients, and which gives a prediction of base pressure-time history for blast wave intersection with missiles. (Dissertation Abstr.)

9851 AN EXTENSION OF THE VON KARMAN-POHLHAUSEN APPROXIMATION METHOD TO MAGNETOHYDRODYNAMIC FLOWS [Thesis]. Hugelman, Rodney Dale. Stillwater, Okla., Oklahoma State Univ., 1964. 89p.

A survey of the literature revealed an almost complete lack of magnetohydrodynamic boundary layer solutions, owing to the mathematical difficulty presented by such problems. It was felt that the von Karman-Pohlhausen technique might be found successful in this instance as it solves the equations governing the flow but once in general terms, the results being a function of parameters dependent upon the body shape. Semi-infinite flat plate, wedge, and circular cylinder flows were examined with variable fluid conductivity. Constant conductivity flows were also considered in the flat plate cases. Magnetic fields were oriented perpendicularly to the surface of the body and both body-fixed and flow-fixed fields were considered. Agreement between this method and existing exact solutions was good in all cases. It was found that since the von Karman-Pohlhausen solution was in closed form it was good for large ranges of the magnetic interaction parameter, while the series solutions of exact methods were convergent for only small values of the magnetic interaction parameter. Wedge flows and circular cylinder flows can also be solved by this method. The method's two prime advantages are its closed form solution and its ability to handle two-dimensional magnetohydrodynamic flow problems not solved by other methods. (Dissertation Abstr.)

9852 ON AXISYMMETRIC FLOWS IN INCOMPRESSIBLE MAGNETOHYDRODYNAMICS [Thesis]. Chow, Chuen-yen. Ann Arbor, Mich., Univ. of Michigan, 1964. 57p.

The phenomena of secondary flow and instability in axisymmetric flows of an incompressible fluid for some specified flow configurations was investigated. In the first problem a current-carrying inviscid fluid of uniform initial velocity passing through an electrically non-conducting axisymmetric converging tube is considered. The nonlinear differential equations are solved by an approximate method for small magnetic Reynolds number. The solution shows that the velocity at the axis is smaller than that at the wall and the difference increases with increasing contraction ratio until a stagnation point appears on the axis and a reversed flow develops downstream from this point. The forward moving fluid is confined to a layer near the wall leading to a hydromagnetic skin effect. By using the same technique another problem is solved to find the secondary flows when an insulated circular cylinder is placed coaxially inside the converging tube, with or without axial electric current flowing inside the cylinder. Because of the approximations used, the method is accurate only when the ratio of the Alfvén wave speed and the fluid speed far upstream from the contraction is small compared with unity. The second problem is concerned with a viscous fluid, which is stationary between two concentric nonconducting circular cylinders. When a uniform electric current is passed axially through the fluid and another current is passed along the axis, the fluid may become unstable due to the nonuniform electromagnetic body force field. The instability sets in as a series of stationary ring vortices along the longitudinal direction. In the analysis a set of differential equations is introduced as an adjoint system to the original set of governing equations. A numerical example is given for the case that the radius of the inner cylinder is one-half of that of the outer cylinder. The result shows that the wave number of the disturbance appearing in the fluid is a constant independent of the magnitudes of applied electric currents. (Dissertation Abstr.)

9853 THE KINETICS OF IONIZATION OF STRONGLY SHOCKED HELIUM [Thesis]. Jeffries, Robert Alan. Norman, Okla., Univ. of Oklahoma, 1965. 115p.

Ionization relaxations occurring behind reflected shocks in helium-filled high-explosive shock tubes were observed with a rotating-mirror smear camera with time resolution of 0.1 μsec and a time-resolved f/3.5 grating spectrograph with time resolution of ~0.3 μsec and spectral resolution of 1.0 Å. Electron density histories of the ionization relaxations were obtained by profile analyses of the Stark-broadened emission lines at 3889, 4471, and 5876 Å. Electron densities indicated by the profiles of the lines at 3889 and 4471 Å were in general agreement. The line at 5876 Å was found to be heavily self-absorbed and unsuitable for this type of analysis. The observed electron density histories were correlated to the relaxation zone state determined from one-dimensional shock calculations, which assumed equal temperatures for He, He^+, and e^-. Agreement between spectrographically determined and calculated equilibrium electron densities was good. The ionization rate was found to be proportional to the 2.3 ± 0.9th power of the mass density and independent of temperature between 2.0×10^4 and 2.25×10^4 °K. However the reactions could not be positively identified. Assuming the reaction to be $He + e^- \rightleftharpoons He^+ + 2e^-$, the ionization and recombination rate constants at 2.25×10^4 °K were equal to 1.1×10^{-13} cm^3 sec^{-1} and 1.0×10^{-30} cm^6 sec^{-1}, respectively. (Dissertation Abstr.)

9854 EXPERIMENTAL DETERMINATIONS OF ELECTRON ENERGY DISTRIBUTIONS FOR TOWNSEND DISCHARGES IN HELIUM GAS [Thesis]. Roberts, Thomas David. Corvallis, Ore., Oregon State Univ., 1965. 89p.

The energy distribution of electrons in Townsend discharges in helium was experimentally investigated in a direct fashion. A discharge is initiated between parallel plates of a small cell mounted at the center of a spherical retarding field energy analyzer. The anode of the cell is perforated and some electrons from the discharge enter the retarding field region. Pressures in the discharge cell are of the order of 1 torr and the pressure in the analyzer region is about 10^{-7} torr, so no significant alteration of the electron energy spectrum due to collisions takes place after electrons have left the discharge cell. The electron current reaching the collecting surface of the analyzer is measured as a function of retarding field strength. The interaction of electrons with the surfaces of the analyzer

is considered, and the experimental data are corrected for the resulting electron reflection and secondary emission. A gold black analyzer surface exhibiting low total electron secondary emission coefficient is utilized. Experimental electron energy distributions are compared with the theoretical calculations of Heylen and Lewis, and qualitative agreement is found for helium. The correction due to electron reflection and secondary emission is shown to be minor. (Dissertation Abstr.)

9855 LINEAR RESPONSE FUNCTION OF A LOW DENSITY ZERO TEMPERATURE SYSTEM OF FERMIONS WITH WEAK VERY SHORT RANGE REPULSIVE INTERACTIONS [Thesis]. **Leonard, Edward John, Jr. Boulder, Colo, Univ. of Colorado, 1963. 138p.**

An attempt was made to perform a natural and practical many-body perturbation calculation of the linear response function of a low-density zero-temperature system of fermions with weak, very short-range, two-body repulsive interactions, in order to discover the physics underlying previous very formal calculations. The calculation was successfully initiated by means of a first-order perturbation calculation facilitated by a new diagram scheme, using given single quasiparticle energies and antisymmetrized two-body quasiparticle interaction matrix elements approximated by the S-wave pseudopotential. A difficult divergence of the type previously found for free particles was clearly seen to be due to certain first-order direct and exchange diagrams for quasiparticle excitations very near the Fermi surface. When these two equally divergent diagrams were combined into a single two-ring-chain and summed with corresponding antisymmetrized diagrams of all orders, a single simple divergence-free approximate response function for a real Fermi fluid was obtained. The physical motivation for this summation and the importance of the included exchange terms is discussed. An approximate analysis of this ring-chain approximation to the response function revealed the presence of a strong very narrow resonance explicitly identified with the zero sound phenomenon first predicted by Landau. The quasiparticle model is discussed in detail and the effective mass calculation is outlined. A possible application of this work to the calculation of the zero sound resonance line (if any) for ^{3}He is briefly discussed. (Dissertation Abstr.)

Geophysics

9856 (AD-622422) INVESTIGATION OF DRIFT IN THE E REGION OF THE IONOSPHERE. Ovezgel'dyev, O.; Korsunova, L. P. Translated from Izv. Akad. Nauk Turkm. SSR, Ser. Fiz. Tekh. Khim. Geol. Nauk, No. 2, 21-6(1964). 10p. (FTD-TT-65-767). CFSTI $1.00 cy, $0.50 mn.

Some experimental observations on drift in the E region of the ionosphere were analyzed in terms of the dynamo theory of geomagnetic variations. (D.C.W.)

9857 AN INVESTIGATION OF THE HEIGHT OF SCINTILLATION-PRODUCING IRREGULARITIES. **Liszka, Ludwik (Kiruna Geophysical Observatory, Sweden). Arkiv Geofys., 4: 523-8(1964).**

A summary of altitude data for scintillation measurements made at Kiruna, Sweden (67°8′N, 20°4′E) is reviewed, and altitudes observed were compared with simultaneous results of vertical soundings and geomagnetic activity. Most studies have shown that the irregularity region lies in the altitude range 250–500 km above the ground, but there were large differences between altitudes obtained from different satellite passages. To investigate the effect of various other geophysical parameters on these altitudes, about 100 records taken during October–December 1962 were analyzed. All heights and height intervals given were obtained under the assumption that the spread in the time delays is due to a real height distribution of irregularities. Attempts were made to determine the dependence of the height at which the scintillation is produced on the type of ionospheric echoes obtained by means of vertical sounding and on geomagnetic activity. (TCO)

9858 THE IONIZED LAYERS OF THE ATMOSPHERE. **Nicolet, M. (Centre National de Recherces de l'Espace, Brussels). Astronaut. Acta, 11: 51-6(1965). (In French).**

The nature of ions in the ionosphere depends on the reactions between solar-radiation produced photoions and neutral atoms. Above the maximum of the electron concentration, the ionosphere composition depends on diffusion. Electrostatic diffusion produces light ions (He, H) instead of atomic O ions. Data are presented for variations in ionic and electron concentrations where the He/O ion ratio is constant and the H/O ion ratio is proportional to the H/O atom ratio. The distribution of the principal atomic bands in the thermopause from 750°K to more than 2000°K is illustrated. The upper part of the ionosphere influences the neutral exosphere by charge exchange between ions and atoms. High-energy particles trapped by the magnetic field of the earth interact with the layer defined by neutral atoms and their ions; this interaction is strongly dependent on solar activity. (BBB)

9859 STUDY OF SOLAR PLASMA FLOW BY THE ZOND-2 INTERPLANETARY STATION. **Bezrukikh, V. V.; Gringauz, K. I.; Musatov, L. S.; Rybchinskii, R. E.; Khokhlov, M. Z. (Radio Engineering Inst., Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 163: 873-6 (Aug. 1, 1965). (In Russian).**

An investigation of solar plasma flow was made to confirm the hypothesis that a correlation exists between the rate of solar plasma flow and the Kp index characterizing geomagnetic disturbances. Solar plasma flow was measured by Zond-2, equipped with modulation and integral particle traps. The latter were modified to measure electron and positive ion flux with energies in excess of 70 and 50 ev, respectively. The modulation trap, similar to the one used on Explorer-10, had a modulating grid supplied by two voltages: a d-c voltage assuming consecutively 8 values between 230 and 3200 v, and a rectangular a-c voltage of 450 v with a modulating frequency of 1000 cps. The instrument was capable of sensing positive ion flow within the range of 10^7 to 2.5×10^9 $cm^{-2}sec^{-1}$. During the flight of Zond-2, the modulation trap was directed toward the sun. When a deviation occurred, a correction was automatically made in the readings based on a study of the angular characteristics of the trap in the laboratory. On 7 Dec 1964, solar plasma flow was recorded at 1.5×10^9 $cm^{-2}sec^{-1}$, coinciding with the geomagnetic storm which occurred on the same date. This value was reached only during strong magnetic storms and tended to confirm the correlation between the Kp index and solar plasma flow. The use of particle traps capable of direct determination of positive-ion flow gave better results than the electrostatic analyzer on Mariner-2. (ATD)

9860 ALTITUDE AND DIMENSIONS OF IONOSPHERIC INHOMOGENEITIES RESPONSIBLE FOR SATELLITE SIGNAL FLUCTUATIONS. I. NIGHT TIME. **Erukhimov, L. M. Kosm. Issled., 3: 584-94(July-Aug. 1965). (In Russian).**

The results of night measurements of F region inhomogeneities by Explorer-7, Discoverer-36, Cosmos-1, and Cosmos-2 are reported. The measurements were conducted during the winter and spring of 1962 and consisted in the recording of signal fluctuations at 20 Mc. In 414 observations, conducted primarily between 1900 hours and 0700 hours, it was found that inhomogeneity concentrations lay primarily in the 280 to 360-km range, very close to the maximum of the F-2 layer and diverging from it by not more than ±70 km. The study of inhomogeneity dimensions indicated that inhomogeneities have a group character, and the small-scale ones were observed to originate from the larger formations, which reached hundreds of kilometers. Inhomogeneities as large as 1 km were observed in the F-2 region, but most of them were in the 200 to 300-m range extending along the Earth's magnetic force lines. A correlation between the appearance of intense small-scale inhomogeneities and the diffusion of reflected signals from the ionosphere was noted. (ATD)

9861 MEASUREMENT OF ELECTRON CONCENTRATION IN THE UPPER IONOSPHERE BY KOSMOS SATELLITES. Misyura, V. A.; Solodovnikov, G. K.; Migunov, V. M. Kosm. Issled., 3: 595-603(July-Aug. 1965). (In Russian).

The electron concentration in the upper ionosphere was measured in October 1962 by determining the phase difference of two coherent signals transmitted from Kosmos II on 20.005 and 90.0225 Mc and received by stations at two different locations in the USSR. Data from 46 observation periods were collected and graphs were plotted of the local electron concentration as a function of time along the satellite path. It was found that local electron concentration N_B increased by a factor of 3 to 4 at the same altitude during passage of the satellite from night to day. For several consecutive days, N_B values repeated themselves within a 20% deviation. Pinching of the upper ionosphere was noted during the transition from maximum to minimum solar activity. Analysis of spectra of ionospheric inhomogeneities showed the existence of a second maximum at 150 to 180 km. (ATD)

9862 SOME POSSIBILITIES AND RESULTS OF IONOSPHERIC MEASUREMENTS OBTAINED BY OBLIQUE OBSERVATION OF THE FARADAY EFFECT OF SIGNALS FROM GEOPHYSICAL ROCKETS. Misyura, V. A.; Osipov, D. D.; Krokhmal'nikov, E. B.; Solodovnikov, G. K. Kosm. Issled., 3: 604-13(July-Aug. 1965). (In Russian).

A method is proposed for determining the vertical distribution of electron concentration and the electron content in a unit ionospheric column, and also their horizontal gradients. The method consists in the diversity reception of radiowaves transmitted by satellites and geophysical rockets. It was used in the observation of the Faraday effect of coherent radio emission on 48 and 144 Mc from a rocket launched on 18 October 1962 to an altitude of 500 km. The smooth, vertical, ionospheric profiles obtained are closely approximated in the F_2 region by the parabolic-exponential model. The concept of ionospheric contraction during decreased solar activity also was confirmed. The agreement of these results with those obtained by vertical sounding of the ionosphere and by the dispersion interferometer method confirmed the validity of the proposed diversity reception method. (ATD)

9863 COMPARISON OF EXPERIMENTAL DATA OF THE EFFECTIVE ION MASS IN THE UPPER IONOSPHERE WITH A THEORETICAL STRUCTURE. Arendt, P. R. (Army Electronics Command, Fort Monmouth, N. J.). Nature, 208: 443-5(Oct. 30, 1965).

An evaluation of the topside ionograms from the Alouette satellite was centered on finding directly the exponential functions that govern the electron-density profiles. Thus by the same process of numerical approximation, the electron density and the scale height are obtained. Therefore, the computation reflects the main natural irregularities that are not smoothed out as by a differentiation of a density profile. The computation describes the electron density versus altitude profile in terms of an exponent and the altitude. The scale height derived directly from the topside ionograms is shown at various times before and after storms and during times of magnetic quiet. Also an average scale height during a magnetically quiet period is given. (J.F.P.)

9864 ELECTRONS IN THE PLASMA SHEET OF THE EARTH'S MAGNETIC TAIL. Bame, S. J.; Asbridge, J. R.; Felthauser, H. E.; Olson, R. A.; Strong, I. B. (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. Lett., 16: 138-42 (Jan. 24, 1966). (LA-DC-7553).

The magnetospheric-tail model of Oxford, Petschek, and Siscoe has a relatively thick neutral sheet region of field reversal. It is expected that a "plasma sheet" associated with "neutral sheet" should exist in the tail. Some experimental observations on the plasma sheet are summarized. (D.C.W.)

9865 POLAR CAP ABSORPTION ON VLF EMISSIONS. Yoshida, Sekiko (Univ. of Alaska, College). Planet. Space Sci., 13: 1165-70(Dec. 1965).

It is shown that vlf emissions are greatly affected by the polar cap absorption caused by the bombardment of solar protons. Characteristics of the PCA effect on vlf emissions are examined and they are in agreement with those obtained by other studies, such as the polar blackout and the cosmic radio absorption. Therefore, the earlier conclusion that the occurrence frequency of vlf emissions decreases in high latitudes during magnetic storms is likely to be due to the PCA effect. Taking the PCA effect into account, it is established that an enhancement of occurrence of vlf emissions occurs at geomagnetic latitudes lower than 67° during the magnetic storm. This suggests that enhanced vlf emissions during geomagnetic storms are generated in the co-rotating region of the magnetosphere or in the outer radiation belt, but not in the tail region. (auth)

9866 ON THE VARIATIONS OF THE THERMOSPHERIC STRUCTURE. Priester, W. (Goddard Space Flight Center, N. Y.). Proc. Roy. Soc. (London), Ser. A, 288: 493-509(Nov. 30, 1965).

The properties of the different effects which have been found to occur in the thermosphere and some conclusions which can be drawn with regard to the physics of the thermosphere are discussed. In the discussion of the diurnal variation the emphasis is on the behavior of the diurnal amplitude in density during the solar cycle. At the height range between 200 and 300 km the amplitude has remarkably increased with decreasing solar activity. The relation between atmospheric density and temperature and the solar e.u.v. flux and the solar 10.7 cm flux—the latter serving as a convenient parameter—is discussed. The observational results for a phaseshift between the variations in the e.u.v. flux (or 10.7 cm flux) and the correlated variations in atmospheric temperature (or density) lie in the range between 0.5 and 2.3 days. During the solar minimum the atmospheric variations which parallel the 10.7 cm flux are far less pronounced than the variations correlated with geomagnetic activity. The phase shift derived from 45 geomagnetic storms and correlated density changes was found to be 6 ± 3 (m.e.) h. (auth)

9867 EFFECTS OF NUCLEAR EXPLOSIONS ON THE IONOSPHERE. Hill, F. L. (United Kingdom Atomic Energy Authority, Aldermaston, Eng.). Radio Electron. Eng., 30: 89-98(Aug. 1965).

The ionization produced in the lower ionosphere by x rays, β particles from neutron decay, and β and γ radiation from fission debris from a nuclear burst is examined. The effects of this increased ionization on the propagation of radio frequency signals in the various bands is considered. (TCO)

9868 THE AURORA. Akasofu, Syun-Ichi Sci. Amer., 213: 55-62(Dec. 1965).

A model is discussed which describes the aurora as a fluorescent luminosity produced by the interaction of atoms or molecules—oxygen, nitrogen, and hydrogen—in the upper atmosphere with energetic protons and electrons entering the atmosphere from space. The basic auroral forms—ribbons and cloudlike patches—are described. The role of the magnetosphere in aurora production is considered. The auroral zones, their variations during magnetic storms, and phenomena occurring during auroral substorms, such as x-ray production and increased ionization of the D and E layers, are described. (M.J.T.)

9869 DERIVATION OF A FORMULA FOR PLANETARY F_2 LAYER IONIZATION. Lal, Chaman (Government of India, New Delhi). Telecommun. J., 32: 401-3 (Oct. 1965).

The monthly mean of the hourly F_2 layer critical frequency data from existing ionospheric stations can be used suitably for arriving at a global or planetary average of critical frequency or ionization of the F_2 layer. Such monthly planetary averages $(\Sigma\overline{foF_2})_p$ are examined over the period 1947–1961. It is shown that planetary F_2 layer ionization shows marked biannual periodicity, with maxima which occur regularly and persistently during the months of April and October. It is found that a simple relation of the form: $(\Sigma\overline{foF_2})_p^2 = K \times F_{10} \times SEF$ agrees

well with the secular variations of planetary F_2 layer ionization over this period. In this expression, K is a constant of proportionality, F_{10} is the solar flux at 2800 Mcps as reported by Covington, and SEF stands for the seasonal enhancement factor. The correspondence between the calculated and observed values of $(\overline{\Sigma foF_2})_p$ is close, the correlation coefficient for the period 1953–1961 being 0.95. However, for part of the previous solar cycle (1947–1952), a slight modification in the value of the constant K is found to be necessary for improving the correlation coefficient. A value of K = 0.36 gives a correlation coefficient of about the same order as for the period 1953–1961. The calculated results for comparison with the observed values are shown. The real significance of this slight change in the value of K between the part of the previous and the current cycle is not clear at present. It is concluded that the biannual periodicity and the equinoctial maxima of planetary ionization are fundamental characteristics of the global F_2 layer ionization. Processes responsible for the seasonal enhancement of global ionization are unknown. It is possible that solar corpuscular activity as manifested by geomagnetic activity which also shows equinoctial maxima may be responsible for the equinoctial maxima of planetary F_2 layer ionization. Or, this response of F_2 layer ionization may be due to causes which have an origin within the earth's atmosphere. (BBB)

9870 VARIOUS IONOSPHERIC PHENOMENA ASSOCIATED WITH MAGNETIC STORMS AND AURORAE. Chandra, Umesh (Univ. of Roorkee, India). Univ. Roorkee Res. J., 8: 73-8(1965).

Features of the various ionospheric phenomena related to the geomagnetic storms and auroras are discussed. These include cosmic rays and geomagnetic storms, ionospheric absorption during auroral and magnetic pulsations, sudden ionospheric disturbances causing radio fade out, and magnetic storms and geomagnetism. Also discussed are the effect of geomagnetic storms on the magnetosphere and some upper atmospheric disturbance over the polar regions. (J.F.P.)

9871 THE VARIATIONS OF TOTAL IONOSPHERIC ELECTRON CONTENT UP TO 1000 km BETWEEN SUNSPOT MAXIMUM AND MINIMUM. Schmelovsky, K. H.; Cumme, G. Z. Meteorol., 18: 176-9(1965).

During 1958 and 1959 total electron content of the ionosphere (N_{tot}) was measured by Faraday fading of Sputnik-III signals at Kuehlungsborn (ϕ = 54° 07′ N; λ = 11° 56′ E; Φ = 54.4° N; Λ = 96.8°E, and these investigations were continued since summer 1963 using Transit 4 A. For comparison all N_{tot} values from Sputnik III were reduced to h = 1000 km. The results obtained during autumn 1963 (Sept.-Nov.) are compared with those of autumn 1958–spring 1959. Diurnal variations of N_{tot} during both periods are shown. (TCO)

9872 A STUDY OF RADIO WAVE ABSORPTION FOLLOWING THE NUCLEAR EXPLOSION OF JULY 9, 1962 [Thesis]. Jusick, Anthony Thomas. Gainesville, Fla., Univ. of Florida, 1965. 102p.

A semi-quantitative order-of-magnitude analysis of the radio wave absorption produced by bomb-generated fission decay electrons trapped in the earth's magnetic field was performed. A technique was developed for calculating the rate of ion production by a high-energy electron confined to a specified trajectory in the earth's magnetic field. This technique was applied to the calculation of the radio wave absorption produced during an 80-second interval beginning approximately 200 seconds after the explosion. The energy spectrum of the incident trapped electrons was then deduced and was found to agree, within a constant factor, with the fission spectrum between 5 and 7 Mev, as determined by others from reactor studies. (Dissertation Abstr.)

Gravitation, Quantum Mechanics, and Relativity Theory

9873 (IC/65/82) DYNAMICAL GROUPS OF SIMPLE NON-RELATIVISTIC MODELS. Boehm, A. (International Centre for Theoretical Physics, Trieste (Italy)). Nov. 1965. 30p. Dep. mn.

The construction of the generators of the dynamical group of the nonrelativistic rotator and the hydrogen atom is discussed. (auth)

9874 (ORNL-3895) ON THE BOUND STATES OF AN ELECTRON IN THE FIELD OF A PERMANENT ELECTRIC DIPOLE. Turner, J. E.; Fox, Kenneth (Oak Ridge National Lab., Tenn.). Dec. 1965. Contract W-7405-eng-26. 50p. Dep. mn; CFSTI $3.00 cy, $0.50 mn.

An exact analysis based on Hamilton-Jacobi theory shows that electronic bound states exist classically for arbitrarily weak dipoles. A quantum mechanical analysis using a trial function of the form $\Psi = \exp(-\alpha r^t)(C_0 Y_{00} + C_1 Y_{10})$, where C_0, C_1, α, and t are variational parameters, Y_{00} and Y_{10} are S- and P-state angular momentum eigenfunctions, and r is the electron's radial coordinate, shows that a bound state exists in the field of both a point dipole and a finite dipole (in the limit of very weak binding) with a dipole moment as small as 1.65×10^{-18} esu-cm. This is lower than the smallest value of Wallis et al. A semiclassical argument based on the uncertainty principle suggests that there is a minimum value of the dipole moment required to bind an electron. A rough estimate indicates that the minimum value may be $D = 0.2 \times 10^{-18}$ esu-cm. (M.O.W.)

9875 ON THE SIGN OF ENERGY OF THE PLANE GRAVITATIONAL WAVES. Khiet, Vu Thanh (Moscow State Univ.). Ann. Inst. Henri Poincare, 2: 261-81(1965).

On the basis of the relative gravitational field concept advanced by Rylov, the energy of Synge's plane gravitational waves, relative to the separate base points, is calculated. It is found that the sign and the value of the energy depend on the base-point position. (D.C.W.)

9876 AN ABSTRACT FORMULATION OF RELATIVISTIC QUANTUM DYNAMICS. Tulczyjew, W. (Univ., Warsaw). Bull. Acad. Pol. Sci., Ser. Sci. Math. Astron. Phys., 13: 433-6(1965).

A general abstract scheme was previously developed for quantum dynamics which was then applied to nonrelativistic theory. The general formalism is applied to relativistic theory of a single free particle without spin. Special choices of proper time operators and corresponding expectation values of position operators are discussed. (auth)

9877 ASYMPTOTICS OF THE EIGENFUNCTIONS OF THE MULTI-PARTICLE SCHROEDINGER EQUATION. Berezin, F. A. Dokl. Akad. Nauk SSSR, 163: 795-8 (Aug. 1, 1965). (In Russian).

The equation $\{-[(\partial^2/\partial x_1^2) + \ldots + (\partial^2/\partial x_n^2)] + \Sigma_{i<j} v(x_i - x_j)\}\psi = \kappa^2\psi$, subject to the condition $v(x) = \int_{\mu_0}^{\infty} e^{-\mu_0 x} |\xi(\mu)| d\mu$, $\int_{\mu_0}^{\infty} |\xi(\mu)|, d\mu < \infty$, $\mu_0 > 0$ is considered where v(x) is the potential. The existence of symmetric and antisymmetric solutions is shown, and a completeness theorem for summable square symmetric and antisymmetric solutions is proven. Asymptotics of these solutions are found. (ATD)

9878 MOTION OF A CHARGED PARTICLE IN THE THEORY OF GRAVITATION. Brezhnev, V. S. Dokl. Akad. Nauk SSSR, 163: 1110-12(Aug. 11, 1965). (In Russian).

In Einstein's gravitational theory, the motion of a material particle is completely determined by the properties of the gravitational field, and the equations of motion are the conditions of integrability of the field equations. The situation is somewhat different with regard to the motion of a charged particle in interacting electromagnetic and gravitational fields. The interaction between electromagnetic and gravitational fields is usually accounted for by introducing an energy-momentum tensor for the electromagnetic field into the right-hand member of Einstein's gravitational equations. This tensor is selected in such a way that equations of motion containing Lorentz force result from the conservation law for the complete energy-momentum tensor of the sources of the gravitational fields. A more systematic method is proposed for formulating gravitational-electromagnetic field equations without the use of particle motion equations, by using the conditions of

consistency of the field equations themselves. It is shown that the motion of charged material particles is completely determined by the properties of the gravitational-electromagnetic field, and that the conditions of integrability of the field equations are the equations of motion for the particles which create the field. (ATD)

9879 FUNCTIONAL VIEWPOINT IN QUANTUM MECHANICS. Gilson, J. G. (Queen Mary Coll., London). Nuovo Cimento (10), 40A: 993-1017(Dec. 21, 1965).

It is shown that by using a probability measure on the space of Feynman's path integrals together with the notion of Hermitian functionals it is possible to express Feynman's results in a mathematically less obscure form. Physical interpretation is discussed, involving a continuation of the configuration variable into the imaginary direction, together with the recognition of a hydrodynamical analogy. These ideas are used to give a new general proof of the equivalence of Feynman's integral and the solution of Schrödinger's equation. Interesting properties of certain paths in the complex plane are discussed. (auth)

9880 WARD RELATIONS FOR GRAVITY. Just, K.; Rossberg, K. (Univ. of Arizona, Tucson). Nuovo Cimento (10), 40A: 1077-87(Dec. 21, 1965).

In close analogy to electrodynamics, the well-known relations of Ward and Takahashi are extended to gravity, which is described by Gupta's formulation of Einstein's theory. (auth)

9881 THE GAUGE DEPENDENCE OF THE GRAVITON PROPAGATOR. Just, K.; Rossberg, K. (Univ. of Arizona, Tucson). Nuovo Cimento (10), 40A: 1088-95 (Dec. 21, 1965).

Although the gauge transformations of gravity involve four arbitrary functions, its reasonable operator transformations are distinguished by a single parameter. A one-dimensional set of reasonable gauges, connected by those transformations, can be established too. Among them, the Feynman gauge and the Landau gauge of gravity are found uniquely. (auth)

9882 THE BOHR-SOMMERFELD QUANTIZATION RULE AND THE WEYL CORRESPONDENCE. Argyres, P. N. (Massachusetts Inst. of Tech., Lexington). Physics, 2: 131-9(Nov. 1965).

With the use of the Weyl correspondence between quantum mechanical operators and classical dynamical functions, an exact quantization rule is derived for a system with one degree of freedom and arbitrary hamiltonian. In the semiclassical limit of small Planck's constant, this reduces to the Bohr-Sommerfeld quantization rule as derived by the WKB approximation. Higher order terms are also derived. It is further proved that for a simple harmonic oscillator the Bohr-Sommerfeld rule must give the exact energy eigenvalues for all states. (auth)

9883 EQUATIONS OF MOTION IN THE INHOMOGENEOUS SL(6,C) SPACE AND A MODEL WHICH GENERATES THE LORENTZ WORLD. Kikkawa, Keiji (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto), 34: 674-92(Oct. 1965).

The Dirac equation, which is invariant with respect to the translation in a 72-dimensional space L_{72} and to the SL (6, C) group and the parity reflection, is introduced. It is shown that the equation is a set of homogeneous and simultaneous equations of the hyperbolic type. Therefore there does not appear an imaginary frequency. Some difficulties, are brought about with the generalization of the space dimension, are illustrated. To overcome the difficulties a gauge theoretical formulation of the 72 translational invariances is introduced. It is shown that there is a couple of gauge fields without which the particle can never propagate, that is, the propagation of the particle is induced by the interaction with the gauge fields introduced. It is also shown that there exists a dissymmetric solution to the equation of motion for the gauge fields. This solution makes the particle propagate only on a restricted manifold in L_{72}, which is regarded as the Lorentz space. By this argument the physical foundation of the non-covariant equation of motion, introduced by Salam et al. and Sakita and Wali, is obtained. Finally it is shown that one of the gauge fields is the gravitational field. (auth)

9884 COMPLEX COORDINATES AND QUANTUM MECHANICS. Strocchi, F. (Laboratoire de Physique Theorique et Hautes Energies, Orsay, France). Rev. Mod. Phys., 38: 36-40(Jan. 1966).

By introducing complex canonical coordinates, classical and quantum mechanics may be embedded in the same formulation. In such a way, the connection between Poisson brackets and commutators, canonical transformations and unitary transformations, etc., becomes apparent. This formulation is also particularly suitable for discussing the classical limit of quantum mechanics and for quantum-statistical mechanics. (auth)

9885 THE ROLE OF BOLTZMANN FACTORS IN LINE SHAPE. Huber, D. L. (Univ. of Wisconsin, Madison); Van Vleck, J. H. Rev. Mod. Phys., 38: 187-204(Jan. 1966).

A study is made of the effect of temperature and environment on the absorption spectra of simple systems. The longitudinal and transverse susceptibilities of a two-level system are analyzed in terms of simple stochastic models. Particular attention is paid to the different roles played by the phase-interruption and frequency-modulation mechanisms. A calculation is given of the susceptibility of a harmonic oscillator perturbed by interaction with other oscillators. The same systems are also studied using Green's function methods. It is assumed that the two-level system is coupled to a crystal lattice by an isotropic interaction that is linear in the lattice displacement. Expressions are obtained for the longitudinal and transverse susceptibilities and comparison is made with the stochastic-model results. The susceptibility of the harmonic oscillator is calculated and found to be identical to the susceptibility obtained by more elementary methods. (auth)

9886 CRITICAL AND BARRIER FIELDS OF TYPE-II SUPERCONDUCTING CYLINDERS OF SMALL RADIUS. Boebel, G.; Ratto, C. F. (Univ., Genoa). Solid State Commun., 3: 177-80(Aug. 1965).

The fields at which single quantized flux threads overcome the surface barrier in a type-II superconducting cylinder of small radius are calculated. These fields are compared with thermodynamical critical fields for the formation of the flux threads and with the experimental values obtained by Boato, Gallinaro and Rizzuto. (auth)

9887 ON WARD RELATIONS [Thesis]. Rossberg, Klaus. Tucson, Ariz., Univ. of Arizona, 1965. 69p.

In quantum electrodynamics and in the theory of the quantized gravitational field the propagators are connected with the corresponding vertex functions by Ward relations. These relations are investigated with respect to the gauge invariance of electrodynamics and gravity. Different methods of their derivation and several generalizations are discussed. The treatment is related to the consistency problems of quantum field theory. In electrodynamics, a class of gauges depending on a single parameter is preferred among all possible gauges. Inconsistencies that seem to arise from operator gauge transformations for the gauge transformed Green's functions are avoided when these Green's functions are represented by Fourier integrals. Thus, the formal derivation of the Ward relation by means of the transformation formulae of the Green's functions in position space is justified. It is shown that Takahashi's derivation of the Ward relation by use of certain equal time commutators also implies a gauge transformation. Some new proofs are given for the Ward relation and its generalizations to many photons. One of these proofs leads to the Ward relation without the detour via the Takahashi relation. Finally a representation of the Ward relation in position space is given. Since the gravitational field also admits a gauge transformation, a Ward relation can be derived for gravity. This is done in Gupta's formalism for gravity. Although a c-number gauge transformation involves four functions, the reasonable operator gauge transformations are determined by a single parameter as in electrodynamics. As a consequence of the Ward relation

for gravity, certain relations for the commutators of the energy tensor with the field of matter are derived. As another application, an equation is found that relates each vertex of matter and photons to the corresponding one of matter and gravitons. In an appendix the transformation formulae for the time ordered Green's functions are derived in the functional formalism for the case that the gauge field is an operator. (Dissertation Abstr.)

Low Temperature Physics

Refer also to abstracts 9231, 9575, and 9896.

9888 (CONF-650512, pp 152-5) SODIUM CRYOGENIC COILS. Taylor, C. E. (Lawrence Radiation Lab., Univ. of California, Livermore).

Two large sodium magnets were built and tested at Livermore to determine the practicality of operating at cryogenic temperatures, where electric resistance drops sharply and power requirements are correspondingly reduced. An experimental 10-in. coil was built and operated at about 21 kG. More recently a 6-in. coil was built with a more practical construction technique using two-layer, spiral-wound pancake modules. Typical operating levels for the 6-in. coil are 330 W and 4300 A for a 22-kG field at 7-10°K, and it was operated as high as 45 kG. Its construction and operation are described. (auth)

9889 (EGG-1183-1192) SUPERCONDUCTING HIGH VOLTAGE DELAY LINE. Cummings, A. J. (Edgerton, Germeshausen and Grier, Inc., Las Vegas, Nev.); Kuettner, H. (Hitemp Wires Co., Westbury, N. Y.). Nov. 19, 1965. Contract AT(29-1)-1183. 30p. (CONF-651203-1). Dep. mn; CFSTI $2.00 cy, $0.50 mn.

From 14th Annual Symposium on Wire and Cable, Atlantic City.

Various types of coaxial cables with superconducting properties were evaluated for both low voltage and high energy pulse propagation. A relationship between pulse widths and voltage levels was observed and their effect on maximum energy propagation was analyzed. A summary of earlier evaluations is given. A new cable construction with a pure niobium inner conductor, Teflon FEP dielectric and a thin tubular layer of high purity lead has shown superior properties as compared to the other types. Voltages up to 5 kv and pulse widths up to 4 microseconds were transmitted at 4.2°K over a length of 1040 feet with a line response of approximately 0.39 nanoseconds. This is an unprecedented rise time commensurate with high voltage capabilities. The characteristic impedance throughout the line is controlled to within less than ±1% in a 50 ohm system resulting in very low reflexions and less than ½ db signal attenuation for the 1040 foot test length including nonsuperconducting leadins. Possible applications in different fields are shown and the basic performance parameters discussed. (auth)

9890 (NP-15699) ELECTROMAGNETIC ATTENUATION OF TRANSVERSE ULTRASOUND IN SUPERCONDUCTORS. Technical Report No. 453. Cullen, James R.; Ferrell, Richard A. (Maryland Univ., College Park. Dept. of Physics and Astronomy). Apr. 1965. Revised June 1965. 16p.

The electromagnetic field set up by a transverse sound wave in a superconductor is screened out by the Meissner effect at temperatures below the transition temperature. Consequently the attenuation produced by electromagnetic coupling to the quasi-particles undergoes an abrupt decrease below the transition temperature. At sufficiently high frequencies the wavelength is short enough that this "rapid fall" is spread out over an appreciable temperature range. Thus measurements of the rapid fall in electromagnetic attenuation can provide a test for theories of the temperature dependence of screening in the superconducting state. Such measurements would have the advantage over the usual penetration depth measurements in that they would study the response of the superconductor to a pure sinusoidal wave and not to an integrated superposition of such waves. But the analysis of the data requires a reliable theoretical expression for the transverse conductivity in the superconducting state. This is computed from the BCS theory along straightforward conventional lines. It is noted that the relevant coherence factors are the same as in the problem of nuclear spin relaxation, and that a logarithmic divergence due to the confluence of the singular density of states functions also enters in the problem. In this case, this divergence is cut off by the finite frequency of the quasi-particle transition. For sufficiently high frequency this anomalous behavior of the transverse conductivity function can result in a "rapid rise" in the transverse attenuation immediately below the transition temperature, before the rapid fall sets in from screening. (auth)

9891 (NP-15700) NORMAL PROCESSES WHICH INHIBIT SUPERCONDUCTIVITY. Technical Report No. 478. Ferrell, Richard A. (Maryland Univ., College Park. Dept. of Physics and Astronomy). July 1965. 10p.

The effective interaction strength for the establishment of Cooper pairs in a degenerate fermion gas is shown to be reduced by a second-order exchange process. In physical terms, the reduction is a consequence of the normal polarization clouds surrounding the individual fermions. Because of the Pauli exclusion principle, these polarization clouds block the approach of further quasi-particles and thereby tend to prevent Cooper pairing. The effect is related to but simpler than that studied by Henley and Wilets in connection with the energy gap of nuclear matter. The second-order suppressive effect is considerable for strong interaction and large state density, and may even prevent the superconducting transition from occurring at all. (auth)

9892 (NP-15817) ON FERROMAGNETISM IN A SUPERCONDUCTING ALLOY. Series A, No. 175. Tsuzuki, Toshio (Tokyo Univ. (Japan). Inst. for Solid State Physics). Oct. 1965. 26p. Dep. mn.

Taking into account spin-orbit interaction, it is shown that ferromagnetism and superconductivity can coexist in an alloy containing paramagnetic impurities. (D.C.W.)

9893 THERMAL SPIKES IN SUPERCONDUCTING THIN FILMS OF Sn AND In. Spiel, Donald E. (Atomics International, Canoga Park, Calif.); Boom, R. W.; Crittenden, E. C. Jr. Appl. Phys. Lett., 7: 292-4(Dec. 1, 1965).

The diffusion of energy from electrons excited by charged particle bombardment was studied by observation of superconducting-normal transitions caused by alpha particles incident on thin films of tin or indium. Because the films were sufficiently narrow, alpha particles initiated transitions across the full width. The transitions were observed by means of the IR drop produced by a transport current. For low current densities, self-terminating voltage pulses were observed. For higher current densities, a normal region initiated by an alpha particle spreads by boundary propagation to the ends of the film as the result of Joule heating. Critical currents are shown with and without alpha particles incident. Also the theoretical and experimental spike radii are shown for 5.3-Mev alpha particles. (J.F.P.)

9894 HARMONIC GENERATION OF MICROWAVES PRODUCED BY A FIELD-EMISSION CATHODE IN A SUPERCONDUCTING CAVITY. Zimmer, H. (Philips Zentrallaboratorium GmbH, Hamburg). Appl. Phys. Lett., 7: 297-8(Dec. 1, 1965).

An experimental set up consisting of a field-emission cathode mounted on the central post of a superconducting re-entrant cavity was used to study the harmonic content of the field-emission current. The harmonic output signal could be held nearly constant for a period of several hours with a residual gas pressure in the field emission tube on the order of 10^{-3} torr. At such a high residual gas pressure d-c field emission is very unstable and tends to produce vacuum arc. The improved stability at microwave frequencies is due to the fact that the power coupled to the cavity is limited, the ions of the residual gas hardly

move under the influence of the high-frequency field, the effect of the change of work function is compensated by the nonlinear character of the emission. The output signal of the fourth harmonic and the field-emission plot of the harmonic generator are shown. (J.F.P.)

9895 IMPROVED STABILITY OF FIELD-EMISSION CURRENT AT MICROWAVE FREQUENCIES. Zimmer, H. (Philips Zentrallaboratorium GmbH, Hamburg). Appl. Phys. Lett., 7: 298-300(Dec. 1, 1965).

Recently experiments were performed with a field-emission cathode at 4.2°K in a superconducting microwave cavity. It was learned that the high-frequency field-emission current is quite stable even under rather poor vacuum conditions. In these experiments the power available for the field emission beam is limited by the power coupled to the cavity. Under these circumstances the vacuum arc cannot arise. The long-term decrease of the field-emission current is also diminished. There are two reasons for this behavior. The first is that most of the ions produced by the field-emission electrons are unable to reach the cathode because they are nearly fixed in position by the high-frequency alternating field. The second reason is that a change of work function by contamination of the cathode influences the microwave-field-emission current much less than the d-c field emission current. This is shown by a short comparative calculation. (J.F.P.)

9896 SUPERCONDUCTIVITY OF ^{99}Tc. Trojnar, E.; Bazan, C.; Niemiec, J. (Inst. of Physics, Polish Academy of Sciences, Wroclaw. Inst. of Structural Research, Polish Academy of Sciences, Wroclaw). Bull. Acad. Pol. Sci., Ser. Sci. Biol., 13: 481-5(1965).

Measurements seemed to indicate that technetium is a type II superconductor. The relations between the magnetic moment of the sample and the field applied at 4.2, 7.2, and 300°K were determined. A frozen paramagnetic moment remained in the sample when the external field was removed. The superconducting transition temperature of technetium was found to be 8.35°K. (M.C.G.)

9897 STRANDED NIOBIUM–TIN SUPERCONDUCTING WIRE. Benz, M. G.; Martin, D. L.; Bruch, C. A. Cryogenics, 5: 248-51(Oct. 1965).

A stranded Nb_3Sn wire was developed and is discussed. The wire has a critical current density of close to 10^5 A/cm^2 at 100 kG and has been used to fabricate solenoids producing magnetic fields above 100 kG. (auth)

9898 A SUPERCONDUCTING DYNAMO—PRINCIPLE AND PERFORMANCE. Van Suchtelen, J.; Volger, J.; Van Houwelingen, D. Cryogenics, 5: 256-66(Oct. 1965).

After a discussion of the principle of a special type of dynamo, an historical and comparative review is given of superconducting dynamos and flux pumps hitherto proposed. Considerable attention has been given to the deviations of our dynamo from ideal behavior. Eddy currents and hysteresis effects limit the applicable speed, but with suitable materials these difficulties are not restrictive in a practical sense. Flux-spot velocities as high as 10^4 cm/sec may be realized in dynamos driven by rotatory magnetic fields. The emf of the dynamo is also affected by the current produced, but reasonable values at higher current levels may still be obtained by proper dimensioning. Technical details of some practical models are presented. (auth)

9899 PULSE METHODS OF INVESTIGATING THE SUPERCONDUCTING PROPERTIES OF ALLOYS. Alekseevskii, N. E.; Dubrovin, A. V.; Egorov, V. S. (Inst. of Physical Problems, Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 163: 1121-23(Aug. 11, 1965). (In Russian).

Two pulse methods for measuring the critical magnetic field intensity of superconducting alloy wires are described. The first is designed for measurements at comparatively small current densities (10^4 amp/cm^2). An external magnetic field of 150 kOe is created in a solenoid (ID 0.5 cm) by means of a discharge of a bank of capacitors (800 μf, 300 v); buildup time to maximum current is 4 msec. The winding of the solenoid is pure Al wire 0.3 mm in diameter, with $\rho_{300K}/\rho_{4.2K} = 300$ and resistance at liquid helium temperature of 2.5×10^{-2} ohm. A voltage proportional to the current in the coil, and consequently to the magnetic field, is passed to the horizontal plate of an oscilloscope, and simultaneous scanning of the magnetic field is effected. A given deviation of the beam from the horizontal corresponds to a given field intensity. The instant of disruption of superconductivity of the sample is registered by the appearance of a resistance between the potential electrodes of the sample. To record the resistance, a d-c measuring current (several dozen milliamperes, 35 kc) is passed through the sample. The signal from the potential electrodes and a signal compensating the measuring current are fed in series to a tuned amplifier. When the critical field intensity is reached, the resistance appears, the compensating signal is blocked out, and a curve of the transition to the normal state appears on the scope. The second method is designed for higher current densities in a stationary field. A short current pulse growing linearly with time is passed through the sample, and a two-beam oscilloscope registers curves of current intensity and voltage at the potential outputs of the sample. Buildup time of the voltage pulses is adjustable from 1 msec to 1 min. Pulses from the generator pass to the feed circuit of the sample from the output of a three-stage transistorized amplifier (gain, 10^5), and a voltage proportional to the current intensity is fed to one input of the scope. The voltage from the potential outputs of the sample are fed to the second input. At the instant of disruption of superconductivity a voltage pulse appears on the scope. The position of this pulse relative to the current-intensity pulse determines the current intensity of the sample. The two pulse devices can be mated by substituting a current pulse from the generator for the d-c measuring current. This pulse is fed to one input of the scope, while the second input handles the unbalanced signal registering the appearance of the resistance. The horizontal sweep is effected by a voltage proportional to the magnetic field. (ATD)

9900 CRITICAL CURRENT OF DISPERSE, SUPERCONDUCTING PHASE PRODUCED BY AGING. Romanov, E. P.; Smirnov, L. V.; Sadovskii, V. D.; Volkenshtein, N. V. (Inst. of Physics of Metals, Academy of Sciences, USSR). Fiz. Metal. Metalloved., 20: 455-8(Sept. 1965). (In Russian).

It is not quite clear whether the conservation of superconducting properties in high magnetic fields is due to the very thin filaments formed by plastic deformation and the decomposition of the solid solution or to a nonhomogeneous lattice structure, involving dislocations, subgrains, and dispersed phases. This problem was examined on a Zr-4% Nb alloy which did not exhibit superconductivity at 4.2°K and could be subjected to thermal treatment (aging), resulting in the precipitation of a superconducting disperse phase. The degree of dispersion could be controlled by changing conditions of the treatment, making it possible to establish correlation between the disperse phase and the various parameters of superconductivity. The alloy, prepared in purified He atmosphere, was annealed at 1280°C for 48 hours. The measurements were carried out at 4.2°K, sending direct current through the specimen by means of soldered contacts. Transition to the normally conducting state was determined by means of a millivoltmeter which operated a relay cutting off the current. The nonsuperconducting character at 4.2°K was not changed by plastic deformation but even short annealing of the deformed specimens above 500°C made them superconducting when cooled to liquid He temperature. The critical current density was found to increase with increasing deformation. The superconductivity is due only to the formation of a disperse phase; the state and the distribution of the precipitated phase and its interaction with the matrix in the normal state determine the critical parameters of superconductivity of the alloy. (TTT)

9901 SUPERCONDUCTING PHOSPHIDES OF THE TRANSITION METALS. Blaugher, R. D. (Westinghouse Electric Corp., Pittsburgh); Hulm, J. K.; Yocom, P. N. J. Phys. Chem. Solids, 26: 2037-9(Dec. 1965).

Phosphides of the transition metals were prepared by the

electrolysis of phosphates dissolved in sodium phosphate melts. Thirteen individual phosphides and several mixtures were tested for superconductivity down to 1°K. Only two phosphides showed superconducting behavior, Mo_3P(T_c = 5.31°K) and W_3P(T_c = 2.26°K). (auth)

9902 PHENOMENOLOGICAL WAVE FUNCTION OF A SUPERFLUID LIQUID IN A POROUS MEDIUM. Mamaladze, Yu. D.; Cheishvili, O. D. (Inst. of Physics, Georgian Academy of Sciences, SSR). JETP Lett. (USSR) (Engl. Transl.), 2: 76-7(Aug. 1, 1965).

In considering the problem of the distribution of the density of a stationary superfluid component in a porous medium, the difficulties connected with the need for taking into account the complicated boundary conditions are avoided by averaging the wave function over a volume containing sufficiently many pores. The increase in the density of the superfluid component in a porous medium bordering on a free volume of a superfluid liquid is connected with the propagation of the wave field of the condensate to neighboring regions, leading, in the case of superconductors, to the Josephson effect. Analogous effects can be observed also in a partition with minute pores separating two volumes of a superfluid liquid. (J.F.P.)

9903 THEORY OF "STEPS" OF VOLTAGE-CURRENT CHARACTERISTIC OF THE JOSEPHSON TUNNEL CURRENT. Kulik, I. O. (Physico-Technical Inst. of Low Temperatures, Academy of Sciences, Ukrainian SSR). JETP Lett. (USSR) (Engl. Transl.), 2: 84-7(Aug. 1, 1965).

In a study of the Josephson tunnel effect several singularities in the transition from superconducting tunneling to single-particle tunneling in a magnetic field have been observed. These singularities are manifest in the fact that the voltage-current characteristic of the tunnel junction consists of steps, the distance between which along the voltage axis is the same and does not depend on H, and the height of which along the current axis depends on the applied magnetic field, assuming a maximum value in a field proportional to the voltage of the step. A theory for this phenomenon is developed. It starts from a hypothesis whereby these effects are caused by the interaction between the Josephson alternating current and the field of the electromagnetic oscillations in a dielectric cavity between the superconductors. (J.F.P.)

9904 CONCERNING ONE-DIMENSIONAL SUPERCONDUCTIVITY. Bychkov, Yu. A.; Gor'kov, L. P.; Dzyaloshinskii, I. E. (Inst. of Physics Problems and Inst. of Theoretical Physics, Academy of Sciences, USSR). JETP Lett. (USSR) (Engl. Transl.), 2: 92-5(Aug. 1, 1965).

The model of a monovalent metal is investigated taking into account both the interaction between the electrons due to Coulomb forces and polarization and the interaction between electrons and ions (phonons). It is important that the system, being one-dimensional, is at the same time sufficiently thick with respect to the Coulomb forces. In this sense it is similar to the molecules of a polymer, in which the transverse dimension of the main chain always amounts to several angstroms, while the Debye radius does not exceed 1 Å. The plasma frequency of such a system does not differ in order of magnitude from the frequency of a three-dimensional metal. Low-frequency oscillations of the electron density are thus forbidden, and this permits electron interactions with small momentum transfer to be disregarded. (J.F.P.)

9905 CONCERNING THE QUANTIZATION OF THE ENERGY LEVELS OF ELECTRONIC EXCITATIONS IN THE INTERMEDIATE STATE OF A SUPERCONDUCTOR. Zavaritskii, N. V. (Inst. of Physics Problems, Academy of Sciences, USSR). JETP Lett. (USSR) (Engl. Transl.), 2: 106-8(Aug. 15, 1965).

An investigation was made to ascertain the extent to which the decrease in the specific heat in the temperature region $kT < kT_0 = \epsilon_0$ in a sample of superconducting tin actually takes place. The characteristic energy ϵ_0 is given by $\hbar v/a$, where v is the velocity of the electrons on the Fermi surface and a is the dimension of the regions of the normal phase of the intermediate state. This decrease in specific heat is one of many characteristics of the normal phase of the intermediate state due to quantization of the energy levels. The specific heat and temperature conductivity of the investigated tin sample, and the specific heat of tin in the intermediate state for different fractions of the normal phase are shown. The measurements made in the region 0.1 to 0.15°K showed that the specific heat of a superconductor decreases in the intermediate state. Although this decrease is only 2 to 3 times larger than the possible experimental error, it can be related to the quantization of the energy levels of the electronic excitations. (J.F.P.)

9906 POSSIBLE SUPERCONDUCTIVITY MECHANISM IN CRYSTALLINE FILMS. Kresin, V. Z.; Tavger, B. A. (Moscow State Extension Pedagogical Inst.). JETP Lett. (USSR) (Engl. Transl.), 2, 101-4(Aug. 15, 1965).

The possibility of the establishment of a superconducting state, due to the presence of different groups of electrons in a crystalline film is considered. The interaction between the electrons of these groups leads, if certain conditions are satisfied, to Cooper pairing. For a quantitative calculation, a model which corresponds to the possible band structure of a semiconducting film is considered. (J.F.P.)

9907 VECTOR PAIRING IN SUPERCONDUCTORS OF SMALL DIMENSIONS. Larkin, A. I. (Moscow Physico-Technical Inst.). JETP Lett. (USSR) (Engl. Transl.), 2: 130-2(Sept. 1, 1965).

It is shown that vector pairing vanishes when pair dimensions are larger than the sample dimension or the electron mean free path. In ordinary scalar pairing the transition temperature is independent of both the sample dimensions and the impurity concentration. The reason for this difference is that in vector pairing the wave function of the pair depends on the direction of the relative momentum of the electrons forming the pair, and vanishes when the momentum uncertainty becomes of the order of magnitude of the pair dimension. (J.F.P.)

9908 CERTAIN SINGULARITIES OF ELECTROMAGNETIC RADIATION GENERATED BY A SUPERCONDUCTING TUNNEL STRUCTURE. Dmitrenko, I. M.; Yanson, I. K. (Physico-Technical Inst. of Low Temperatures, Academy of Sciences, Ukrainian SSR). JETP Lett. (USSR) (Engl. Transl.), 2: 154-6(Sept. 1, 1965).

Preliminary results of an experimental investigation of the spectral composition of the Josephson high-frequency radiation are presented. The tunnel structure investigated had a very uniform layer of oxide between metal films, so that a clear-cut picture of the steps was observed. From the experimental results it is concluded that the Josephson radiation is not a noise effect, having a rather narrow spectral composition, and the bandwidth of the radiated frequencies can amount to less than about 10^{-3} of the central frequency. Also the dependence of the spectral composition of the radiation on the constant magnetic field confirms the mechanism proposed previously for the interaction between the tunnel-current density wave and the electromagnetic wave. (J.F.P.)

9909 DEPENDENCE OF THE DENSITY OF ROTATING LIQUID HELIUM ON THE ANGULAR VELOCITY. Andronikashvili, E. L.; Tsakadze, D. S. (Inst. of Physics, Academy of Sciences, Georgian, SSR). JETP Lett. (USSR) (Engl. Transl.), 2: 177-9(Sept. 15, 1965).

An experiment was performed to ascertain the velocity dependence of the density of helium(II), in which a sensitive pycnometer was set in rotation. The dependence of the density of helium(II) on the rotary speed at constant temperature is shown. It was observed that when the helium(II) is twisted it becomes much denser, and the increase in density rises with the temperature and with the angular velocity. It is concluded that some specific mechanism condensing the helium(II) exists. It is not connected with the presence of centrifugal pressure, but apparently with the existence of quantized vortices of the Onsager-Feynman type. It is reported that a jump was observed in the density of the liquid helium as it went through the phase transition point, thus offering evidence that during rotation

the He(II)-He(I) phase transition is of first and not second order. (J.F.P.)

9910 OBSERVATION OF DYNAMIC INTERMEDIATE STATE OF SUPERCONDUCTORS WITH THE AID OF MICROCONTACTS. Sharvin, Yu. V. (Inst. of Physics Problems, Academy of Sciences, USSR). JETP Lett. (USSR) (Engl. Transl.), 2: 183-5(Sept. 15, 1965).

An experiment was performed in which the continuous motion of superconducting and normal layers under stationary external conditions was observed. A diagram of this experiment is shown. Plots of the resistance versus time are shown, in which it is seen that the resistance varied periodically, with the maximum value corresponding to the normal state of the sample near the contact. The velocity of these layers is calculated. It is concluded that the motion of the layers arises only when some additional factors prevent the layers from becoming oriented perpendicular to the current direction. This method may be suitable for the investigation of the motion of vortices in type-II superconductors. (J.F.P.)

9911 INTRODUCTION TO A THEORETICAL EXPLANATION OF SUPERCONDUCTIVITY. Morel, P. (Univ., Paris). Onde Elec., 45: 912-25(July-Aug. 1965). (In French).

A theoretical explanation of superconductivity is presented. (D.C.W.)

9912 MAGNETIC PROPERTIES OF TYPE II SUPERCONDUCTORS. de Gennes, P. G. (Univ. Paris, Orsay, France). Onde Elec., 45: 926-31(July-Aug. 1965). (In French).

An analysis of the properties of type-II superconductors is presented. (D.C.W.)

9913 THE SUPERCONDUCTIVE RESONATORS AND THEIR APPLICATIONS. Septier, A. (Univ. Paris, Orsay, France). Onde Elec., 45: 932-45(July-Aug. 1965). (In French).

The theoretical bases of superconducting resonators are summarized, together with some related experimental observations. The use of superconducting cavities in oscillators with very high stability and in waveguides is discussed, and the status of these applications is summarized. (D.C.W.)

9914 THE STUDY OF SOME PROBLEMS RELATED TO WINDINGS OF SUPERCONDUCTING CABLES. Donadieu, L. (Compagnie Generale d'Electricite, Marcoussis, France). Onde Elec., 45: 958-65(July-Aug. 1965). (In French).

Some problems in the use of multi-wire cables in superconducting windings are studied. Some experimental results on the performance of such windings are included. (D.C.W.)

9915 EFFECT OF 3d TRANSITIONAL IMPURITIES ON THE SUPERCONDUCTING TRANSITION OF ALUMINIUM. Aoki, R.; Ohtsuka, T. (Tokyo Univ.). Phys. Lett., 19: 456-7(Dec. 1, 1965).

The change in the superconducting transition temperature induced by 3d impurities is investigated in order to shed light on the problem of the influence of d-state ions on superconductivity. In order to correlate the change in the transition temperature with the behavior of the residual resistance, measurements are extended to other elements of the 3d group (Ti, V, Cr, Mn, Fe, and Ni). An attempt was made to obtain a sufficient amount of reliable points in order to determine the various mechanisms affecting the transition temperature. The change of superconducting characteristic parameters of the aluminum alloys, from the experimental results, is shown. It is found that the anisotropy part is nearly independent of the type of impurity. But the valence factor has a distinct minimum at manganese. It is suggested that this anomalous behavior is mainly due to the change in the electron-electron interaction. (J.F.P.)

9916 SOME EFFECTS OF SAMPLE GEOMETRY UPON THE OCCURRENCE OF FLUX JUMPS IN HARD SUPERCONDUCTORS. Morton, N. (General Electric Co., Ltd., Wembley, Eng.). Phys. Lett., 19: 457-9(Dec. 1, 1965).

Several series of jumps were recorded using a field sweep, for samples of Nb_3Sn and for 75% Nb 25% Zr alloy. The experimental results are shown for the Nb–Zr sample. The sample was varied in size, and these results are also shown and discussed. It is found that for small thickness the data tend toward a finite value, rather than zero. Qualitatively similar results were obtained with Nb_3Sn specimens, although some of the jumps disappeared entirely at very low sweep rates. It is concluded that the existence of a succession of flux jumps must imply periodic fluctuations in temperature according to current theories, but the results do not accord with the idea that cumulative heating, even if modified by cooling due to the surroundings, explains the origin and rate dependence of all jumps. (J.F.P.)

9917 SPATIAL VARIATIONS OF FLUX MOTION IN HARD SUPERCONDUCTORS. Wischmeyer, C. R. (Rice Univ., Houston, Tex.). Phys. Lett., 19: 543-5(Dec. 15, 1965).

Some observations of spatial variations in flux penetration of thin-walled cylindrical tubes of a hard superconductor are reported. In these experiments the sample is maintained in the critical state by a slowly changing axial magnetic field. It is noted that, in at least some instances, abrupt, highly localized and correlated flux motion is observed more or less simultaneously at the inner and outer surfaces of the thin-walled section, without catastrophic flux jump, and that the axial extent of these events is small compared to a millimeter scale. Although direct evidence of the size of a flux disturbance is lacking, it is still possible to estimate very roughly the local average values of energy density, temperature rise, and the change of field with time. An energy density of $1\ (10)^{-4}$ joule/gram is obtained, which, it is estimated, would raise the local temperature 0.2°K above the 4.2°K helium bath. Similarly, the estimate of the change in field with time is $2\ (10)^{5}$ G/sec. (J.F.P.)

9918 Δ/n STRUCTURE OF Pb–PbO–Pb TUNNEL JUNCTIONS. Marcus, S. M. (E. I. du Pont de Nemours and Co., Wilmington, Del.). Phys. Lett., 19: 623-5(Jan. 1, 1966).

It is reported that the current through evaporated Pb–PbO–Pb superconducting tunneling junctions shows bumps centered at voltages which are submultiples of the Pb energy gap. (auth)

9919 RATE-DEPENDENT DISSIPATION IN TYPE II SUPERCONDUCTORS IN SWEPT D.C. FIELDS. Maxwell, E.; Robbins, W. P. (Massachusetts Inst. of Tech., Cambridge). Phys. Lett., 19: 629-31(Jan. 1, 1966).

Dissipative phenomenon in the mixed state of type II superconductors are reported, and explanations suggested. (auth)

9920 ANOMALOUS RESISTIVE TRANSITIONS IN INHOMOGENEOUS Pb-Sb SUPERCONDUCTING ALLOYS. Joiner, W. C. H. (Westinghouse Aerospace, Baltimore). Phys. Lett., 19: 634-5(Jan. 1, 1966).

Inhomogeneous Pb–Sb superconducting alloys are shown to possess resistive transitions which cannot be described by the present theory of type II materials. The transitions of samples of widely different composition are similar, and hence the critical fields appear to be independent of resistivity. (auth)

9921 MAGNETIZATION INSTABILITIES IN REVERSED FIELDS FOR INHOMOGENEOUS Pb-Sb SUPERCONDUCTING ALLOYS. Joiner, W. C. H. (Westinghouse Aerospace, Baltimore). Phys. Lett., 19: 636-7(Jan. 1, 1966).

The magnetic transitions of quenched samples of Pb–Sb alloys show non-ideal magnetization curves and have upper critical field values which do not correspond to the GLAG theory. Reversed field annihilation instabilities are seen in all samples after room temperature precipitation. (auth)

9922 THERMAL RESISTIVITY AT Pb–Cu AND Sn–Cu INTERFACES BETWEEN 1.3 AND 2.1 deg K. Barnes,

L. J.; Dillinger, J. R. (Univ. of Wisconsin, Madison). Phys. Rev., 141: 615-20(Jan. 1966).

Measurements were made of the thermal resistivity at lead–copper and tin–copper interfaces for $1.3 \leq T \leq 2.1°K$. By the application of a magnetic field the lead or the tin could be transformed from the superconducting to the normal state. This permitted measurements of the changes in the thermal resistivity at the interface between two metals produced by allowing one of the metals to become superconducting. The thermal resistivity at an interface formed by vacuum casting lead onto copper was found to be 9.3 $T^{-3.7°}K$ cm^2/W with the lead superconducting. An interface formed by growing a single crystal of lead onto a single crystal of copper had an interface resistivity of 9.3 $T^{-4.3°}K$ cm^2/W with the lead superconducting. Upon application of a magnetic field to make the lead normal, the thermal resistivity at the interface dropped to a value too small to measure reliably, less than 0.04°K cm^2/W. These measurements suggest that the heat transfer across Pb–Cu interfaces by electrons is increased considerably by changing the lead from the superconducting to the normal state. The thermal resistivity at the interface between tin and copper, with the tin superconducting, was about $\frac{1}{5}$ as great as that for lead and copper, with the lead superconducting. An alloy zone formed at tin–copper interfaces obscures to some extent the nature of the resistivity at these interfaces. However, heat transfer at Sn–Cu interfaces appears to be dominated by electrons with the tin either superconducting or normal. Heat transfer by electrons at all interfaces behaves qualitatively in a manner similar to the thermal conduction by electrons in the superconductor used. A rod made of alternate layers of Pb and Cu had a much larger thermal resistivity with the lead superconducting than with it normal. This suggests the use of such a sandwich structure as a thermal switch. (auth)

9923 LAMBDA TRANSITION IN ADSORBED HELIUM AT $T > T_\lambda$. Goodstein, D. L.; McCormick, W. D. (Univ. of Washington, Seattle). Phys. Rev. Lett., 16: 8-11(Jan. 3, 1966).

Adsorption isotherms were measured for ^4He on Ar-coated Cu in the temperature range from 2.08 to 2.77°K. The results indicate that a phase transition corresponding to the lambda transition in bulk ^4He occurs in the adsorbed film at temperatures above T_λ for pressures below the bulk vapor pressure. (D.C.W.)

9924 GEOMETRICAL RESONANCE AND BOUNDARY EFFECTS IN TUNNELING FROM SUPERCONDUCTING In. Tomasch, W. J. (Atomics International, Canoga Park, Calif.). Phys. Rev. Lett., 16: 16-19(Jan. 3, 1966).

The tunneling characteristics of Al–AlO_x–In film diodes in which both the Al and In were superconducting were investigated. The results support the view that thick films of certain superconductors exhibit geometrical resonances (standing-wave modes) to which tunneling electrons may lose energy in quantum-assisted transitions. (D.C.W.)

9925 RADII OF POSITIVE AND NEGATIVE IONS IN HELIUM II. Parks, Peter E.; Donnelly, R. J. (Univ. of Chicago). Phys. Rev. Lett., 16: 45-8(Jan. 10, 1966).

The radii of positive and negative ions in He(II) were calculated from previous measurements of the mean lifetimes of ions trapped on quantized vortex rings and lines. (D.C.W.)

9926 VOLTAGE ASSOCIATED WITH THE COUPLED MOTION OF FLUX IN TYPE-I SUPERCONDUCTORS. Solomon, P. R. (United Aircraft Corp., East Hartford, Conn.). Phys. Rev. Lett., 16: 50-2(Jan. 10, 1966).

The potential differences across two superconducting strips separated by a thin insulating layer were measured as a function of the current passed through the lower superconductor for several values of magnetic field and temperature. The results confirm that the potential difference across a type-I superconductor in the intermediate state is due to the motion of vortices. (D.C.W.)

9927 THEORY OF GEOMETRICAL RESONANCES IN THE TUNNELING CHARACTERISTICS OF THICK FILMS OF SUPERCONDUCTORS. McMillan, W. L.; Anderson, P. W. (Bell Telephone Labs., Murray Hill, N. J.). Phys. Rev. Lett., 16: 85-7(Jan. 17, 1966).

The oscillations which appear as a function of voltage in the tunneling current from thick, well-annealed films of superconducting lead and indium and which are enhanced by a very thin silver coating are explained as a simple quasiparticle interference effect caused by scattering from a perturbation in the energy-gap function on or near the film surfaces. (G.O.Y.)

9928 MAGNETIC STATE OF GADOLINIUM IMPURITIES IN SUPERCONDUCTING LANTHANUM. Klein, Michael W. (Sperry Rand Research Center, Sudbury, Mass.). Phys. Rev. Lett., 16: 90-1(Jan. 17, 1966).

On the basis of a model in which the Gd impurities interact via a Ruderman-Kittel-Yosida interaction, evidence is presented that only short-range magnetic order exists in superconducting Gd–La. (D.C.W.)

9929 NONLINEAR FLUX FLOW IN TYPE-II SUPERCONDUCTORS. Farrell, D. E.; Dinewitz, L; Chandrasekhar, B. S. (Western Reserve Univ., Cleveland). Phys. Rev. Lett., 16: 91-4(Jan. 17, 1966).

The resistance was measured as a function of current for superconducting type-II In–Pb alloys over a wide range of current, composition, temperature, pinning strength, and applied magnetic field. The data exhibit a "similarity principle" which seems to arise from a modification of the Lorentz driving force on a flux line. (D.C.W.)

9930 DIRECT EVIDENCE OF STEADY EMF INDUCED BY FLUX MOTION IN SUPERCONDUCTORS. Pearl, Judea (Radio Corp. of America, Princeton, N. J.). Phys. Rev. Lett., 16: 99-100(Jan. 17, 1966).

The production of a steady emf by flux line motion in superconductors was experimentally verified. A voltage was observed between the terminals of a lead coil (made of superconducting ribbon) within which a permanently magnetized screw was rotated. It was concluded that the origin of the voltage is associated with the hydrodynamics of the superfluid microstructure. (D.C.W.)

9931 SUPERCONDUCTIVITY OF TUNGSTEN. Johnson, R. T. (Univ. of Illinois, Urbana); Vilches, O. E.; Wheatley, J. C.; Gygax, Suso. Phys. Rev. Lett., 16: 101-4(Jan. 17, 1966). (COO-1198-316).

The critical field of tungsten was measured in several runs down to $T^* = 3m$ deg K on the magnetic temperature scale of powdered cerium magnesium nitrate. The superconducting transition temperature was also measured. A very pronounced supercooling effect was observed and was discussed in terms of the Ginzburg-Landau theory. (G.O.Y.)

9932 ZERO-SOUND EXCITATIONS IN ^4He. Etters, Richard D. (Douglas Aircraft Co., Long Beach, Calif.). Phys. Rev. Lett., 16: 119-22(Jan. 24, 1966).

The energy spectrum for density-like fluctuations in a boson fluid was calculated in detail. It was concluded that the excitations should be more appropriately associated with zero-sound oscillations in the "collisionless" regime rather than with ordinary sound. (G.O.Y.)

9933 RECENTLY PROPOSED RELATIONSHIP FOR SUPERCONDUCTORS. Grunzweig-Genossar, J.; Revzen, M. (Technion-Israel Inst. of Tech., Haifa). Phys. Rev. Lett., 16: 131-2(Jan. 24, 1966).

It is shown that Lewis' general thermodynamic relation between the energy gap of a superconductor and the slope of the critical field at the critical temperature approximates numerically an empirical relation proposed by Toxen. It is concluded that Toxen's relation is a numerical coincidence rather than a fundamental relation for superconductors. (G.O.Y.)

9934 THE SUPERCONDUCTING TRANSITION TEMPERATURES OF SOME DILUTE LEAD ALLOYS. Gamari-Seale, Helen; Coles, B. R. (Imperial Coll. of Science and Tech., London). Proc. Phys. Soc. (London), 86: 1199-1204(Dec. 1965).

Measurements were made of the change in T_c produced by small additions of Cd, Hg, In, Tl, Sn, (TlBi), Sb and Bi to lead. For the ternary isoelectronic Pb(TlBi) system a

good fit of the data can be made to the Markowitz and Kadanoff model of anisotropy and valence contributions to ΔT_c, and this yields a mean square anisotropy $\langle a^2 \rangle$ of 0.004. This quantity was used to derive valence contributions for the binary alloys, but these differ from values calculated on simple assumptions. (auth)

9935 DIRECT EVIDENCE FOR QUANTIZED FLUX THREADS IN TYPE-II SUPERCONDUCTORS. Boato, G.; Gallinaro, G.; Rizzuto, C. (Univ., Genoa. Istituto Nazionale di Fisica Nucleare, Genoa). Solid State Commun., 3: 173-6(Aug. 1965).

Abrikosov's flux threads were detected by a dynamical method in cylindrical Pb–Tl specimens with radii comparable to the penetration depth. The entrance and escape fields of successive flux threads were measured. The entrance fields are higher than the critical fields for formation of flux threads and are interpreted as barrier fields for the threads. The characteristic time for the entrance or escape of a thread is less than 10^{-5} sec. (auth)

9936 SUPERCONDUCTIVITY IN SEMICONDUCTORS. Vul, B. M.; Selivanenko, A. S. (Lebedev Inst. of Physics, Moscow). Soviet Phys.-Solid State (Engl. Transl.), 7: 1510(Dec. 1965).

Translated from Fiz. Tverd. Tela, 7: 1876-7(June 1965).

A degenerate p-n junction with a material in which both electron and hole superconductivity can be established is discussed. (D.C.W.)

9937 SUPERCONDUCTING FILMS IN A MAGNETIC FIELD. Lei, Hsiao-lin (Shantung Univ., China). Wu Li Hsueh Pao, 21: 1619-37(Sept. 1965). (In Chinese).

The theory developed previously was extended to thicker films. The compensation equation and current equation are derived for superconducting films in a magnetic field, on the basis of a model which assumes the energy-gap function to be constant over the whole film and by means of Schrieffer's technique. The equations obtained are applied to discuss the influence of an external magnetic field on the superconducting properties of a metallic film and its transition changes. The formulas for determining energy-gap, magnetic moment, and critical fields H_c, H_{c_1} and H_{c_2} which correspond respectively to equilibrium transition and to boundaries of supercooled and superheated region, are given. All the expressions have been reduced to the well-known results of the Ginzburg-Landau theory in the local limit and to those in the thin film limit. Non-local effects in the general case have been discussed in detail. (auth)

Neutron Physics

See also REACTOR TECHNOLOGY — Criticality Studies

Refer also to abstracts 9265, 9379, and 9960.

9938 (BNL–9770) THE INTERPRETATION OF PULSED NEUTRON EXPERIMENTS. Corngold, Noel (Brookhaven National Lab., Upton, N. Y.). Dec. 1965. Contract AT(30-2)-Gen-16. 27p. (CONF-660203-2). Dep. mn. CFSTI $2.00 cy, $0.50 mn.

From National Topical Meeting on Reactor Physics in the Resonance and Thermal Regions, San Diego, Calif.

Neutron experiments carried out in non-multiplying media, which are homogeneous in composition and simple in shape, are discussed. The problem of decay constants (time eigenvalues) for a particular system is discussed. Solutions were derived for an infinite media. Some of these results are applied to water, heavy water, beryllium, and graphite. (M.O.W.)

9939 (EUR–2536.e) CALCULATION OF MULTIGROUP EXTRAPOLATION LENGTHS AND NEUTRON CAPTURE CYLINDERS SURROUNDED BY PREDOMINANTLY SCATTERING MEDIA WITH THE THRILL PROGRAM. Ponti, C. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center. European Atomic Energy Community, Ispra (Italy). European Scientific Data Processing Center). July 1, 1965. 28p. Dep. mn.

The purpose of the THRILL code is the determination of some parameters which permit one to deal with cylindrical absorbers surrounded by predominantly scattering media, in the frame of the diffusion theory: namely the code computes the linear extrapolation length of the flux at the surface of the absorber, fictitious diffusion parameters of the absorber, blackness of the cylinder, absorption rate per unit flux and area of the cylinder surface, ratio between the average flux inside the absorber and the surface flux. The absorber may contain two coaxial cylindrical regions, the inner may be absorbing and scattering, the outer only absorbing. The calculation is done in a multigroup scheme, and the results are then averaged for few groups, by means of the neutron spectrum calculated in the surrounding medium. (auth)

9940 (EUR–2584.e) A PROGRAMME FOR THE SOLUTION OF THE MONOENERGETICAL TRANSPORT EQUATION IN THE P5 APPROXIMATION FOR A MULTI-REGION CYLINDRICAL GEOMETRY. Massimo, L. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Oct. 5, 1965. 40p. Dep. mn.

A computer program which solves the monoenergetic transport equation in the P_5 approximation for a multi-region cylindrical geometry is described. The program is written in FORTRAN II for the IBM 7090. (D.C.W.)

9941 (GAMD–6692) GAVER—A NEUTRON CROSS SECTION AVERAGING PROGRAM. Smith, C. V.; Drake, M. K. (General Atomic, San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science). Sept. 1, 1965. Contract AT(04-3)-167. 21p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

The computer program GAVER, which was written for use on the IBM 7044 to compute average cross sections for a set of fine energy groups, is described. The program listing is included, together with sample input and output. (D.C.W.)

9942 (IDO–17125) WIGLE-40, A TWO-GROUP, TIME-DEPENDENT DIFFUSION THEORY PROGRAM FOR THE IBM 7040 COMPUTER. Radd, M. E. (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). Dec. 1965. Contract AT(10-1)-205. 61p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

The computer program WIGLE-40, a one-dimensional, two-energy-group, time-dependent diffusion theory program for the IBM 7040 computer, is described. The program is restricted to one-dimensional slab geometry with zero-gradient or zero-flux boundary conditions. The number of delayed neutron groups may be zero, one, or six. Arbitrary time-dependent changes can be made in the parameters in the diffusion equations to introduce perturbations or feedback into the system. A sample problem and a complete FORTRAN listing of the program are included. (auth)

9943 (ORNL-P–1885) THE MEASUREMENT OF NEUTRON TOTAL CROSS SECTIONS IN THE RESONANCE ENERGY REGION AND THE DETERMINATION OF RESONANCE ABSORPTION. Harvey, J. A. (Oak Ridge National Lab., Tenn.). [1965]. Contract W-7405-eng-26. 32p. (CONF-660204–2). Dep. mn. CFSTI $2.00 cy, $0.50 mn.

From American Nuclear Society Meeting, San Diego, Calif.

A method of determining resonance absorption cross sections from measurements of total cross sections is demonstrated using transmission data obtained on the low-energy resonances of tungsten isotopes. (D.C.W.)

9944 (RPI–328-44) THERMALIZATION PROGRAM AT RENSSELAER POLYTECHNIC INSTITUTE. Daitch, P. B. (Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Nuclear Engineering and Science). [1965]. Contract AT(30-3)-328. 23p. (CONF-660203-4). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From National Topical Meeting on Reactor Physics in the Resonances and Thermal Regions, San Diego, Calif.

A summary of the experimental and theoretical studies of thermalization that are being carried out at Rensselaer Polytechnic Institute is presented. (D.C.W.)

9945 NEUTRON EXPERIMENTS AT THE 4.5-Mev VAN DE GRAAFF. Throw, Francis E. (Argonne National Lab., Ill.). Argonne Nat. Lab. Rev., 2: 71-5(Oct. 1965).

The 4.5-Mev Van de Graaff generator and the neutron source used for neutron experiments at Argonne are briefly described. The neutron detectors, experimental arrangements, and some results for the following experiments are discussed: lifetimes of nuclear excited states; neutron polarization and differential cross sections; neutron scattering in the Kev region; and scattering and capture cross sections. (L.B.S.)

9946 COMPUTATION OF DIFFERENTIAL CROSS SECTIONS FOR SLOW NEUTRON SCATTERING BY MEANS OF INTEGRATION WITH RESPECT TO TIME. Turchin, V. F. At. Energ. (USSR), 19: 428-32(Nov. 1965). (In Russian).

A method is proposed for calculating the differential cross sections for the scattering of slow neutrons on coupled atoms by means of integration of the Van Hove formula, introducing under the integral sign a cutoff factor which leads to an averaging of the cross section over some energy range, and this result in turn can be used to compare theoretical and experimental data. The method demonstrated enables the differential cross sections for a liquid to be calculated according to a model proposed previously. Calculations for water and ice near the melting point reveal the presence of a discontinuity in the total cross section at the ice-to-water transition; this result agrees with the experimental data of Heinloth. (tr-auth)

9947 AN APPLICATION OF THE THEORY OF SINGULAR INTEGRAL EQUATIONS TO NEUTRON FLUX PROBLEMS IN CYLINDRICAL GEOMETRY. Sahni, D. C. (Atomic Energy Establishment, Trombay, India). Energia Nucl. (Milan), 12: 582-92(Nov. 1965).

The solution of the steady state integral Boltzmann equation is considered in a two region cylindrically symmetric system. The inner region is a scattering and absorbing medium, which may also contain isotropic sources. The outer region contains uniform isotropic sources, and is purely scattering with a cross section equal to the total cross section of the inner medium. The method consists in reducing the problem to a system of coupled singular integral equations. A numerical method for their solution is discussed. Flux distributions and linear extrapolation distances are determined for cylindrical cells of infinite radii. (auth)

9948 ON THE SPECTRUM OF THE SPACE-INDEPENDENT BOLTZMANN OPERATOR. Ukai, S. (Kyoto Univ.). J. Nucl. Energy: Pt. A and B, 19: 833-48(Nov. 1965).

The eigenvalue problem arising in the study of the space-independent Boltzmann equation which describes the neutron velocity distribution in an infinite homogenous medium was investigated. Under general physical plausible conditions, the existence of an essential spectrum was proved. The point spectrum was studied for the mono-atomic gas model in which the mass of medium atoms is treated as a parameter and was found to contain a denumerable set of isolated (discrete) eigenvalues in some finite interval. (auth)

9949 EFFECTIVE CADMIUM CUTOFF ENERGIES FOR NON-1/V DETECTORS. Yasuno, Takehiko (Japan Atomic Energy Research Inst., Tokyo). J. Nucl. Sci. Technol. (Tokyo), 2: 427-31(Nov. 1965).

Effective cadmium cutoff energies were calculated for ^{239}Pu, ^{235}U, ^{115}In, Au, ^{191}Ir and ^{176}Lu as a function of the cadmium filter thickness, the most probable energy of the Maxwellian flux, and the epi-thermal index. An infinite slab geometry and isotropic flux were assumed in the calculations. (auth)

9950 EFFECTIVE RESONANCE INTEGRALS FOR LOW ENERGY RESONANCES. McKay, M. H. (Univ. of New South Wales, Kensington); Keane, A.; Pollard, J. P. J. Nucl. Sci. Technol. (Tokyo), 2: 445-9(Nov. 1965).

By using a different approximation to the slowing-down density, the accuracy of the effective resonance integral proposed by McKay was extended to very dilute mixtures of an absorber with a moderator. The formula was applied to the 6.68-ev resonance of ^{238}U and the 1.054-ev resonance of ^{240}Pu to give results in excellent agreement with "exact" calculations for mixtures of various dilutions at 0° and 900°K. (auth)

9951 CADMIUM CUTOFF ENERGIES FOR RESONANCE ABSORBERS IN ACTIVATION AND REACTIVITY MEASUREMENTS. Brown, H. L. Jr.; Connolly, T. J. (Stanford Univ., Calif.). Nucl. Sci. Eng., 24: 6-17(Jan. 1966).

A method for calculating effective cadmium cutoff energies to be applied to measured resonance integrals of Doppler-broadened-resonance absorbers, as well as 1/v absorbers, is described. The method is applied to infinite slab, infinite cylinder, and sphere configurations in which the absorber, at some uniform concentration, occupies all the space within the cadmium cover. It is pointed out that the effective cutoff value applying to an activation measurement of a resonance integral differs from that applying to a reactivity measurement under otherwise identical conditions. The development of calculations for both cases is presented. Some results are given for gold, indium-115, plutonium-240, and the 1/v absorbers, boron and vanadium, as a function of sample configuration, cadmium thickness, absorber density, temperature, and neutron spectrum. Many of these values differ significantly from the nominal 0.5 ev. (auth)

9952 RESONANCE ABSORPTION IN PARTICLES. Lewis, R. A.; Connolly, T. J. (Stanford Univ., Calif.). Nucl. Sci. Eng., 24: 18-25(Jan. 1966).

The theory of Lane, Nordheim, and Sampson for the calculation of the effective resonance integral in media containing absorber in the form of small particles was tested by comparison with experiment. Measurements were made on samples containing gold particles in a range of volume fractions from 0.1 to 30%. Two diluent materials, lead and graphite, were used to test the effect of the type of material admixed with the absorber particles in the samples. Comparison of the theory and experiments was made on the basis of the calculated and measured decrease in effective resonance integral of the particle case relative to the corresponding homogeneous case with the same average absorber and diluent density. The results show that, for small absorber volume fractions, there is good agreement between theory and experiment, if the theory is suitably modified to describe the experiment. This agreement also extends to volume fractions above 10%, although the results of the theory are in question in this range. (auth)

9953 INTEGRAL TRANSPORT THEORY. Aswad, Adnan A.; Dalton, G. R. (Univ. of Florida, Gainesville). Nucl. Sci. Eng., 24: 49-59(Jan. 1966).

The one-velocity time-independent neutron integro-differential transport equation is converted into an integral equation by the use of a homogeneous Green's function. The neutron flux, Green's function, and source are expanded in spherical harmonics. The integrations over the angles are carried out by the use of the spherical harmonic orthogonality relation. The net result is a set of coupled integral equations in the flux angular moments. Relations that give the Green's function angular moments are derived for any nonreentrant geometry and all boundary conditions applicable to the neutron transport equation. The conditions for which the scalar flux and some of the flux higher moments can be calculated exactly are discussed. Sample problems of unit slab cells that meet these conditions, are solved. The results are found to be in excellent agreement with those of the DS16 and the TRANVAR codes. A method to estimate the effect of the flux non-

zeroth angular moments and the spatial truncation errors on the scalar flux is introduced. A sample problem of a heterogeneous unit slab cell is presented. It is found that the errors in the scalar flux due to neglecting the flux non-zeroth angular moments and the spatial truncation error are each of the order of 0.03% for this problem. (auth)

9954 THE GENERALIZED FIRST-FLIGHT COLLISION PROBABILITY IN THE CYLINDRICALIZED LATTICE SYSTEM. Takahashi, Hiroshi (EURATOM, Ispra, Italy). Nucl. Sci. Eng., 24: 60-71(Jan. 1966).

The method of first-flight collision probabilities in an isotropic scattering medium is developed for an anisotropic scattering medium, and a closed form of the expression for the circularly cylindricalized cell is formulated. A reciprocity relation and neutron conservation for the generalized first-flight collision probability are discussed. As an application, the thermal-neutron spectrum in the uranium light-water lattice, which was studied in Brookhaven National Laboratory, is calculated using the FIRST II code, and numerical results for the disadvantage factor of dysprosium activation are compared with results calculated by Honeck using the transport approximation. It is shown that the transport approximation gives fairly good results. (auth)

9955 A SYNTHETIC KERNEL FOR A HEAVY SPECIES. Wilkins, Coleridge A. (Wollongong University Coll., New South Wales, Australia). Nucl. Sci. Eng., 24: 89-90(Jan. 1966).

A common approximation is shown to lead to a useful synthetic kernel for scattering by a heavy species. (L.B.S.)

9956 THE LATTICE MODEL CONCEPT OF STOCHASTIC NEUTRON TRANSPORT [Thesis]. Hungerford, Herbert Eugene. Lafayette, Ind., Purdue Univ., 1965. 186p.

Solutions of the Boltzmann transport equation are examined in order to determine their validity to describe the transport of neutrons at large distances in a material from a neutron source, and then an alternative method of describing neutron transport under these conditions is considered. The result is the development of a new type of stochastic neutron transport code, the lattice model concept. A basic assumption of the lattice model is that neutron motion may be sampled at predetermined points such as may exist at line intersections on a gridwork or lattice. Space is visualized to be filled with a cubic lattice whose unit distance between lattice points may be some fraction of a mean free path, or otherwise chosen arbitrarily. Neutron motion is allowed to proceed from a given lattice point to any other adjacent one, giving 26 allowed directions for the motion, each of which encompasses a portion of the complete solid angle. At each position the motion is sampled to determine whether or not a collision has occurred between the sampling points. If no collision has occurred, the particle is allowed to proceed to the next sampling point in the same direction and with the same speed it had at the given sampling location. If a collision has occurred, the type of collision is determined. If it is a non-capture collision, new directions of motion are chosen and the corresponding speed and energy changes are calculated. If the collision is a capture collision, the nature of the capture process is determined. In this manner neutron histories are generated within a material, and end whenever a capture occurs, or when it has exceeded some limiting condition on space, time, or energy. A computer code named PULANT was developed using this stochastic approach. As a test of the validity of this new approach, this code was used to calculate the neutron flux from an isotropic fission source in an infinite medium of graphite. Appendices describe the code and present a compilation and sample output from the code. (Dissertation Abstr.)

9957 THE APPLICATION OF VARIATIONAL METHODS TO NEUTRON THERMALIZATION PROBLEMS [Thesis]. Razminas, Robert B. Gainesville, Fla., Univ. of Florida, 1965. 174p.

Methods based on the variational method, VM, and the generalized variational method, GVM, are applied to the calculation of the thermalization parameters $\overline{D}_0$ and C_0 associated with the asymptotic time eigenvalue through the power series $\lambda = \alpha_0 + \overline{D}_0 B^2 - C_0 B^4$ for the pulsed neutron experiment in crystalline media. A procedure is given for determining only the lowest or asymptotic eigenvalue without recourse to parametric methods using selected values of the geometric buckling, B^2. The trial functions selected to represent the energy spectrum are the Laguerre polynomials of order 1 weighted by the energy Maxwellian. However, the general development of the analysis is not restricted to these functions. Any suitable complete set of polynomials could be utilized. Several examples incorporating low ordered trial functions are given to provide a detailed description of the mechanics of adapting the VM and the GVM to the problem and also to allow an analytic comparison of the parameters obtained from the two methods. General equations from which thermalization parameters can be obtained using high ordered trial functions are developed for both the VM and the GVM. Also included are tabulations of pertinent Laguerre weighted integrals (up to 18 polynomials) of energy-dependent scattering cross-section parameters obtained from the scattering kernel $\Sigma_S(E' \rightarrow E)$ selected to represent the scattering interactions that may occur in the particular medium. The calculation of the various integrals and hence the thermalization parameters is transformed to a discrete energy representation. The scattering kernels used in the calculations for the crystalline media beryllium and graphite are based on the energy exchange model formulated by Parks, and tables of the kernel data for the selected energy points used in this study are included. The influence of the energy mesh size upon the values of the thermalization parameters is investigated and discussed. Also discussed is the convergence behavior of the parameters obtained using both the VM and the GVM. The values of the thermalization parameters $\overline{D}_0$ and C_0 obtained in this study for beryllium and graphite respectively are: 1.33×10^5 cm^2/sec and 6.47×10^5 cm^4/sec; 2.15×10^5 cm^2/sec and 16.06×10^5 cm^4/sec. (Dissertation Abstr.)

9958 NEUTRON GENERATOR WITH A TARGET. Fujii, Isao (to Tokyo Shibaura Electric Co., Ltd.). Japanese Patent 1964-18488. Aug. 31, 1964. Filed Sept. 7, 1963.

An improved neutron generator with a target intended especially for the production of high-flux neutrons is proposed. The feature of the neutron generator is the use as target materials of either hydroxides of alkali metals (e.g., of lithium, sodium, zirconium, rubidium, cesium, etc.) their hydrides (e.g., hydrides of lithium, sodium, etc.). (NSA of Japan)

Nuclear Properties and Reactions

Refer also to abstracts 9641, 9724, 9768, and 9786.

9959 (AEET-214) VAN DE GRAAFF LABORATORY PROGRESS REPORT, [JANUARY 1-DECEMBER 31, 1964]. David, T. P. (comp.) (Atomic Energy Establishment, Trombay (India). Nuclear Physics Div.). 1965. 90p. Dep. mn.

An outline is presented of the operations, design modifications, experimental and data-processing facilities, and instrumentation for the 5.5-Mev Van de Graaff accelerator at the Atomic Energy Establishment Trombay in India. The design of a He ion source, a polarized-^{3}He ion source, an electron-bombardment apparatus for preparing thin-film radiation targets, and ion pumps for pressures of 0.01 to 10 μ Torr utilizing gettering or sputtering are discussed. Studies are reported on ^{40}Ca($\alpha,\alpha'\gamma$), ^{27}Al(p,p'γ) and (p,α), ^{37}Cl(p,nγ), ^{19}F(α,n), ^{13}C(α,n), ^{235}U(n,fission), and ^{40}Ca(n,α) at 2 to 5.5 Mev. (T.F.H.)

9960 (AEET-228) PROGRESS REPORT ON NUCLEAR DATA ACTIVITIES IN INDIA, [NUMBER] II. (Atomic Energy Establishment, Trombay (India). Nuclear Physics Div.). July 1965. 39p. Dep. mn.

Experimental studies of reactions, decays, energy levels,

and spectra of nuclei are outlined. Also discussed are neutron-scattering studies of solids. (T.F.H.)

9961 (ANL–7029, pp 1-3) STUDIES WITH THE BROAD-RANGE MAGNETIC SPECTROGRAPH. Braid, T. H.; Chasman, R. R.; Erskine, J. R.; Friedman, A. M. (Argonne National Lab., Ill.).

An experimental investigation of actinide nuclei is being conducted with (d,p), (d,t), and (d,d') reactions. Spectroscopic information such as energies, wave functions, and identities of intrinsic and collective states is being acquired. The spectrum of protons at 140° from a ^{240}Pu target bombarded with 12-Mev deuterons is given. (M.O.W.)

9962 (ANL–7029, pp 9-12) ATOMIC-BEAM STUDIES. Childs, William; Dalman, John; Goodman, Leonard (Argonne National Lab., Ill.).

Data obtained with the Mark II atomic beam magnetic resonance apparatus are summarized. New values of electronic g factors, and of magnetic-dipole and electric-quadrupole hyperfine interaction constants are presented for a number of low-lying atomic levels of various isotopes of Ni, Cr, Mn, Ge, Fe, and V. The use of a swept r-f signal in coordination with a multichannel analyzer for data gathering is discussed. (M.O.W.)

9963 (BNL–9637) ANGULAR CORRELATIONS OF INTERNAL PAIRS. Nuclear Spin-Parity Assignments. Warburton, E. K.; Alburger, D. E. (Brookhaven National Lab., Upton, N. Y.). [1965]. Contract AT(30-2)-Gen-16. 40p. (CONF-651118–2). Dep. mn; CFSTI $2.00 cy, $0.50 mn.

From American Physical Society, Gatlinburg, Tenn.

The angular correlation of interpal pairs was utilized in an intermediate-image pair spectrometer to determine the multipolarities of nuclear electromagnetic transitions. The method consists of measuring the pair-line yield using a special spiral baffle system which selects positron-electron pairs emitted at large relative angles and comparing this with the yield without the baffle. Ratios $R_\omega = (Y_{\text{with baffle}})/(Y_{\text{without baffle}})$ were calculated theoretically for various multipoles and are found to fit accurately the data for calibration lines of known multipolarity. Unknown lines are then compared with the master set of R_ω curves. Corrections for nuclear alignment effects are discussed. A review is given of the work done to date with this device, designated as a multipole meter, and measurements on transitions from the 5.96-Mev level of ^{10}Be are reported. It is shown that this state is a doublet, one member of which is $J^\pi = 1^-$ decaying predominantly by an E1 ground-state transition and the other member of which has even parity decaying predominantly to the 3.37-Mev first-excited state of ^{10}Be. A critique of the method is presented and future applications are discussed. (auth)

9964 (CNEA–160) FUNCION DE EXCITACION PARA LA REACCION ^{197}Au(d,p)^{198}Au. (Excitation Function of the Reaction ^{197}Au(d,p)^{198}Au). Nassiff, S. J.; Quel, E.; Testoni, J. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1965. 10p. Dep. mn.

The excitation function for the reaction ^{197}Au(d,p)^{198}Au was measured using the technique of superimposed metal sheets. The results were compared with values obtained with a model proposed by Peaslee in which a direct reaction mechanism is assumed. (D.C.W.)

9965 (IAE–878) EFFEKTY OBOLOCHEK V ENERGII YADRA. (Shell Effects in the Energy of Nuclei). Strutinskii, V. M. (Institut Atomnoi Energii, Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow). 1965. 24p. Dep. mn.

Nuclear shells correspond to some inhomogeneous distribution of nucleons in phase space, while in quasiclassical phenomenological models, such as the drop model, the nucleon distribution is assumed to be homogeneous. The shell correction to the drop-model energy of the nucleus is calculated as a function of the nucleon number and the deformation, using the Nilsson level scheme. The magnitude of this correction is in agreement with the known value for the semi-empirical formulas for nuclear mass. The calculated nuclear deformation and the boundaries of the shells of deformation also agree with experiment. The pairing energy is calculated, but it does not play a substantial role. (tr-auth)

9966 (IAE–885) VYSVECHIVANIE YADER NIKELYA POSLE ZAKHVATA TEPLOVOGO NEITRONA. (De-excitation of Ni Nuclei After Thermal Neutron Capture). Groshev, L. V.; Demidov, A. M.; Shadiev, N. (Institut Atomnoi Energii, Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow). 1965. 12p. Dep. mn.

Gamma-transition schemes of the nuclei ^{59}Ni, ^{61}Ni, and ^{63}Ni were constructed on the basis of data obtained in measurements of the gamma spectrum from the (n,γ) reaction on nickel isotopes. A comparison of the emission of protons in the (d,p) reaction with the matrix elements of gamma transitions from the initial state is presented. The mechanism of capture of thermal neutrons in these nuclei is discussed. (tr-auth)

9967 (IAE–940) OB IZMERENII REZONANSNYKH YADERNYKH PARAMETROV PRI RASSEYANII NA REGULYARNYKH SISTEMAKH. (On Variation of Resonance Nuclear Parameters in Scattering on Regular Systems). Kagan, Yu.; Afanas'ev, A. M. (Institut Atomnoi Energii, Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow). 1965. 20p. Dep. mn.

Scattering on systems of nuclei with low-lying resonance levels is studied. It is found that, if the nuclei form a regular one-dimensional chain or two-dimensional lattice, then the elastic width and the position of the resonance level undergo substantial changes. It is shown that the change of the width is associated with the lifetime of the collective excited state of the system of nuclei. The lifetime of such a state and the corresponding width can be both larger and smaller than the lifetime (width) of an isolated excited nucleus. It is shown that in the case of a three-dimensional crystal the elastic width, in general, disappears and the energy dependence of the resonance interaction is determined only by the inelastic width. In the presence of spin in the ground state of the nucleus and if inelastic scattering through phonons plays a noticeable role, the width takes a value intermediate between the inelastic width and the total width. (tr-auth)

9968 (INSJ–89) NUMERICAL DIFFERENTIAL CROSS SECTIONS OF SOME REACTIONS ON ^{13}C INDUCED BY 54.9 Mev PROTONS. Taketani, H.; Yamaguchi, H.; Muto, J.; Kokame, J.; Inoue, N.; Tomita, S.; Nakamura, H. (Institute for Nuclear Study, Tokyo Univ. (Japan)). Sept. 29, 1965. 22p. Dep. mn.

Numerical differential cross sections of (p,d) and (p,t) reactions on ^{13}C are presented. The target used is a self-supporting film of thickness 3.7 mg/cm^2 (^{13}C, 56%; ^{12}C, 44%). The energy of the incident protons is 54.9 ± 0.4 Mev. Momentum analysis of the reaction products is performed with a magnetic analyzer, operated with momentum resolution of about 0.3%. Nuclear photographic plates are used for the detection of the reaction products. In some cases, aluminum absorbers of various thicknesses are placed in front of the plates for the discrimination of various particles. In (p,d) reactions, seven prominent deuteron groups corresponding to the excitation energies of 0, 4.43, 7.66, 9.64, 12.71, 15.11 and 16.11 Mev in ^{12}C are observed. Angular distributions (some not complete) are obtained for these groups only. In (p,t) reactions, four prominent triton groups corresponding to the ground, first (1.99 Mev), second (4.38 Mev), and third (4.82 Mev) excited states in ^{11}C are observed. Angular distributions (some not complete) are obtained for these groups only. Absolute cross sections are obtained. Absolute uncertainties are believed to be less than 30%. (auth)

9969 (JINR-P-2386) DIFFERENTSIALNYE SECHENIYA REAKTSII D(t,α)n V INTERVALE ENERGII 115-1650 Kev. (Differential Cross Sections for D(t,α)n Reaction in the Energy Range 115-1650 Kev). Kobzev, A. P.; Salatskii, V. I.; Telezhnikov, S. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1965. 10p. Dep. mn.

The differential cross sections for the D(t,α)n reaction were measured at 90° in the lab system in the energy range 115–1650 kev. The reaction cross sections measured earlier by others in the energy range from 115 up to 300 kev and from 1450 up to 1650 kev were confirmed. A difference (up to 10%) in the cross sections was found if compared with the earlier obtained data in the energy region from 300 up to 1450 kev. (auth)

9970 (LA-3383) FISSION PRODUCT YIELDS FROM FAST (≈ 1 Mev) NEUTRON FISSION OF ^{239}Pu. Anderson, Carl A. Jr. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). July 1965. Contract W-7405-eng-36. 24p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

The sixteen measured yields of fission products from fast fission of Pu-239 published through June 1965 are given. Information is presented which indicates the restricted range of mass numbers within which mirroring, or reflection, of data is applicable. Use of this information enables generation of fairly reliable guesses for six reflected data points. A curve fit to these data provides interpolated estimates of unmeasured mass chain yields. A modified equal-charge-displacement hypothesis is used to estimate independent and cumulative fission yields of nuclides. (auth)

9971 (MIT-2098-201) APPLICATION OF FINITE POTENTIALS TO NUCLEAR MATTER. I. PERTURBATION THEORY. Sprung, Donald W. L. (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science). Nov. 1965. Contract AT(30-1)-2098. 33p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

The application of second-order perturbation theory to nuclear matter was simplified by the definition and tabulation of a set of generalized Euler functions. Explicit expressions were derived for the contributions of all the potential terms that are likely to be required in a two-nucleon interaction. The formalism was applied to Bressel's potential, a modified Hamada-Johnston potential in which the infinite hard cores are replaced by finite square potentials. (D.C.W.)

9972 (NAA-SR-11231) CHAD—CODE TO HANDLE ANGULAR DATA. Berland, R. F. (Atomics International, Canoga Park, Calif.). Dec. 31, 1965. Contract AT(11-1)-Gen-8. 79p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

The computer code CHAD was written as part of the effort to automate the analysis of data for the Cross Section Analysis and Applications Project. The program accepts differential scattering data in various formats, specified as a function of energy and angle; and converts this information to a Legendre expansion compatible with the Atomics International Evaluated Nuclear Data File (AIENDF). CHAD also accepts tabulated Legendre coefficients in any one of several normalizations, and converts this to the AIENDF format. One of the major features of CHAD is the recursive method for calculating the transformation matrices which convert Legendre coefficients from one frame of reference (laboratory or center of mass) to the other. CHAD permits rapid inspection of input and output data by means of an automatic graphical display package. (auth)

9973 (NP-15816) A SURVEY OF FAST NEUTRON REACTIONS. Lectures held at the Third Winter School of Nuclear Physics, Villars, Switzerland, January 1965. Cindro, Nikola (Institut "Rudjer Boskovic," Zagreb (Yugoslavia)). 1965. 124p. Dep. mn.

A survey of studies of fast-neutron reactions is presented stressing the trends in such studies. Studies of reaction mechanisms and nuclear structure are considered, together with developments in experimental techniques. 165 references. (D.C.W.)

9974 (PUC-937-171) DEFORMATIONS IN THE SHELL MODEL WITH APPLICATION TO Ca SPECTROSCOPY [Thesis]. Bertsch, George F. (Princeton Univ., N. J. Palmer Physical Lab.). Aug. 1965. Contract AT(30-1)-937. 97p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

The collective aspect of nuclear behavior is studied for isotopes of oxygen and calcium. Usual shell-model calculations consider the dynamics of a few valence particles and treat the core as spherically symmetric and inert. The core polarization has a substantial effect on the system energy of even parity excitations. The Nilsson model predicts about the same energy shifts from core-polarization. A detailed comparison is made between the Nilsson wavefunctions and the perturbation theory wavefunctions, and it is found that there is a high overlap between the two types of wavefunction. An effective two-body force for valence particles may be defined to include second-order energy corrections from core-polarization. This is calculated for ^{18}O, ^{42}Ca, ^{210}Po, and a particle-hole interaction in ^{16}O. These corrections for ^{42}Ca, combined with a calculation of the first-order two-body interaction from a realistic force, reproduce the empirical spectrum of ^{42}Ca quite well. The theory of deformations is applied to the low-lying excitations of ^{40}Ca and ^{42}Ca. Because the excited states, which are assumed to be deformed, are so close to the shell-model states, there is considerable mixing between the two types of wavefunction. This implies that transition strengths between states should be strong. The mixing of deformed and shell-model states also affects stripping and pickup reactions, to distribute the single-particle strength over several levels. These features are in qualitative agreement with experiment. (auth)

9975 (PUC-937-174) AN INVESTIGATION OF J DEPENDENCE IN NEUTRON PICKUP REACTIONS [Thesis]. Glashausser, Charles M. (Princeton Univ., N. J. Palmer Physical Lab.). Oct. 1965. Contract AT(30-1)-937. 242p. Dep. mn; CFSTI $6.00 cy, $1.25 mn.

Differential cross sections were measured for the following reactions: ^{56}Fe(p,d)^{55}Fe at 18.5, 20.0, 22.4, 25.7, and 27.5 Mev; ^{58}Ni(p,d)^{57}Ni at 20.0, 25.4, and 27.5 Mev; ^{12}C(p,d)^{11}C, ^{32}S(p,d)^{31}S, and ^{208}Pb(p,d)^{207}Pb at about 28 Mev; and ^{56}Fe(He^{-3},α)^{55}Fe at 30 and 40 Mev. Pronounced J dependence was found to persist for both $l = 1$ and $l = 3$ transfers in the ^{56}Fe(p,d) and ^{58}Ni(p,d) reactions over the entire energy range studied; changes with energy are gradual but definite. The spin dependence of $l = 2$ distributions in the ^{32}S(p,d)^{31}S reaction is equally striking, but essentially no J dependence was observed for either $l = 1$ or $l = 3$ transfer in the ^{208}Pb(p,d)^{207}Pb reaction. Back angle differences between $\frac{1}{2}^-$ and $\frac{3}{2}^-$ distributions in the ^{12}C(p,d)^{11}C reaction cannot be definitely called J dependence, since Q dependence is apparently important The ^{56}Fe(He^{-3},α)^{55}Fe reaction revealed a small but noticeable phase difference between $\frac{5}{2}^-$ and $\frac{7}{2}^-$ distributions. Various theoretical methods were used in an attempt to explain J dependence. Results of these analyses are presented. (M.O.W.)

9976 (RT/FI(65)30) CORRECTION OF FAST NEUTRON CROSS SECTIONS BY INTEGRAL EXPERIMENTS. Farinelli, U. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Sept. 1965. 10p. Dep. mn.

A simple model for correlating results of integral experiments with group cross sections is discussed. The method is compared with iterative procedures previously used. The physical assumptions on which both methods are based are critically analyzed. (auth)

9977 (TID-22403) NUCLEAR REACTIONS IN LIGHT NUCLEI AND MOESSBAUER STUDIES. (Johns Hopkins Univ., Baltimore, Md. Dept. of Physics). Nov. 1965. Contract AT(30-1)-2028. 162p. Dep. mn; CFSTI $5.00 cy, $1.00 mn.

Studies are reported on: the ^{57}Fe Moessbauer effect in Fe and Fe_2O_3, as studied using Van de Graaff-induced (d,p) reactions and Coulomb excitation; ^{57}Fe γ-ray absorption by sodium ferrocyanide; an analysis of all possible Moessbauer nuclei; Moessbauer studies of the internal conversion coefficients of the first excited state in ^{169}Tm, produced by beta decay of ^{169}Er; detection of Moessbauer effect in ^{57}Fe 137-kev transition from the second-excited state; Moessbauer effect in ^{57}Fe at high temperatures; the polarization of ^{57}Fe nuclei by the Moessbauer effect; Moessbauer measurements of the proton spectra and ^{12}B

polarization from $^{11}B(d,p)^{12}B$ reactions at 2.8 and 3 Mev; mechanisms and distributions for $^{19}F(d,n)^{20}Ne$; the design of a pulsed ion source for the Johns Hopkins 3-Mev Van de Graaff accelerator; and instrumentation for Moessbauer measurements. (T.F.H.)

9978 (TID–22462) STUDIES ON ELECTROMAGNETIC PROPERTIES OF EXCITED STATES OF NUCLEI. Annual Progress Report, 1965. Metzger, F. R. (Bartol Research Foundation, Swarthmore, Pa.). Dec. 13, 1965. Contract AT(30-1)-3525. 12p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

Studies of strongly perturbed γ-γ angular correlations were carried out using gaseous and metallic sources of ^{127}Xe. A two-rotor facility capable of relative velocities of 3600 mi/hr was designed, built, and tested. Resonance scattering experiments were carried out with ^{42}Ca, ^{125}Te, ^{159}Tb, and ^{193}Ir, using radioactive isotopes in the gaseous phase or in conjunction with the high speed rotor facility. Theoretical studies were concerned with the shell model description of isobaric analog excitations, the spreading of these excitations due to the Coulomb interaction, and the particle widths of analog states. (M.O.W.)

9979 (TID–22478) THE ELASTIC SCATTERING OF 160 Mev PROTONS FROM ^{9}Be, ^{40}Ca, ^{58}Ni, ^{120}Sn AND ^{208}Pb. Technical Report 475. Roos, Philip G.; Wall, N. S. (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science. Maryland Univ., College Park. Dept. of Physics and Astronomy). July 1965. Contract AT(30-1)-2098. 26p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

Using a good resolution total energy scintillation spectrometer the elastic scattering differential cross sections of 160-Mev protons from ^{9}Be, ^{40}Ca, ^{58}Ni, ^{120}Sn, and ^{208}Pb were measured. Optical model analyses of the data were made, and the pertinent parameters are given. The most significant result of the analyses is that the extent of the imaginary part of the optical potential is of the order of 10^{-13} cm greater radius than the real part of the potential, independent of atomic weight. (auth)

9980 (UCRL–16419) NUCLEAR MAGNETIC MOMENTS AND HYPERFINE ANOMALIES OF ^{186}Re, ^{188}Re, AND ^{241}Am, ^{242}Am [Thesis]. Armstrong, Lloyd Jr. (Lawrence Radiation Lab., Univ. of California, Berkeley). Sept. 23, 1965. Contract W-7405-eng-48. 93p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

The nuclear magnetic moments of ^{186}Re, ^{188}Re, ^{241}Am, and ^{242}Am were measured using the method of triple resonance in an atomic beam. The hyperfine anomalies for Am and Re were determined from the experimental values. In addition, the hyperfine structures of Am and Re were calculated relativistically. It was found that relativistic effects alone explain the hyperfine structure of Re, but that both relativistic effects and core polarization are needed to explain the hyperfine structure of Am. The nuclear moments of Am and Re were also calculated by the Nilsson model. (D.C.W.)

9981 (WASH–1064) REPORTS TO THE AEC NUCLEAR CROSS SECTIONS ADVISORY GROUP MEETING AT DUKE UNIVERSITY, OCTOBER 13–14, 1965. Motz, H. T. (comp.) (European–American Nuclear Data Committee). 221p. (EANDC(US)–79(U)). Dep. mn. CFSTI $6.00 cy, $1.25 mn.

Summaries and abstracts that were presented to the AEC Nuclear Cross Sections Advisory Group are included. These summaries contain statements of recent development, changes of emphasis, and preliminary data which are of importance to the cross section measurement program of the AEC. Also included are a number of pertinent publications listed by title, author, and journal. (C.E.S.)

9982 (MLM–1285(tr)) STUDY OF BACKWARD DIFFUSION OF ELECTRONS AS A FUNCTION OF ENERGY. Suzor, F.; Charpak, G. Translated for Mound Lab., Miamisburg, Ohio, from J. Phys. Radium, 13: 1-10(Jan. 1952). 27p. Dep. mn; JCL $2.60 fs, $1.01 mf.

Two half-cylindrical Geiger-Müller counters, placed one on each side of a radioactive source deposited on a flat sheet of aluminum, have permitted the study of backward diffusion of the β radiation in a 2π solid angle emitted by the nuclides ^{35}S, ^{60}Co, ^{22}Na, ^{210}Bi, and ^{32}P. The same experiments were made with conversion electrons emitted by ^{99m}Tc and ^{115m}In. (auth)

9983 POLARIZATION OF NEUTRONS FROM THE $^{7}Li(p,n)^{7}Be$ REACTION AND FROM SCATTERING BY ^{12}C. Minzatu, I. (Inst. of Atomic Physics, Bucharest). Acad. Repub. Pop. Rom. Stud. Cercet. Fiz., 17: 13-69(1965). (In Rumanian).

The angular distribution of the polarization of fast neutrons emitted in the $^{7}Li(p,n)^{7}Be$ reaction, which is a typical fast neutron source, was examined for proton energies of 4.3 and 4.5 Mev. The neutrons emitted during the reaction are monoenergetic only at energies up to 2.378 Mev, the excitation threshold; beyond $E_P = 6$ Mev a second excited group appears. The polarization is quite marked in regions removed from resonances. In order to establish the polarization of a particle with a given spin $\underline{s}$, the density matrix formalism was used. The protons falling on the Li target cause the (p,n) exchange reaction; the neutrons emitted under an angle l were elastically scattered by the ^{12}C scatterer and were recorded by a scintillation detector under angles of θ and $-\theta$. The degree of polarization was derived from the experimentally determined asymmetry. The protons were accelerated in a cyclotron, cooling the 0.8-cm diameter and 2 to 3 mg/cm^2 thick Li target by an air jet. The threshold of the reaction is 1.88 Mev. The energies of the neutrons emitted in the direction of $\theta = 0°$ for bombardment with 4.3 and 4.5-Mev neutrons were $E_n = 2.5$ and 2.7 Mev, respectively. With increasing angles θ the neutron energy decreased, reaching a value of 1.48 Mev for $\theta = 135°$. On this basis the angular distribution of the polarization was plotted. The polarization became 0 for $\theta = 60°$. The results indicate that in the energy range 4 Mev $< E_P < 4.9$ Mev, the ^{8}Be nucleus, formed by the bombardment of the ^{7}Li nucleus, does not possess resonances. Between 4 and 5 Mev, the reaction generates polarized neutrons, with a yield of 35% between 20 and 40°. (Thesis, 133 refs.) (TTT)

9984 CONTRIBUTIONS TO THE THEORY OF ELASTIC SCATTERING OF PARTICLES WITH SPIN. Brandus, Ioan (Inst. of Atomic Physics, Bucharest). Acad. Repub. Pop. Rom. Stud. Cercet. Fiz., 17: 135-202(1965). (In Rumanian).

Study of the relation between collision matrices and the interaction potential may lead to the clarification of the nature of nuclear forces. For this reason, integral equations were derived concerning the parameters of the collision matrices in the case of elastic scattering of particles with an arbitrary spin, valid of any scattering angle, basing the calculations on similar studies involving the elastic scattering of deuterons on nucleons with zero spin. After expressing the density matrix of the final spin states by the form of the collision matrix, the average values of the spin operators which characterize the spin state of the final beam (Fano tensors) were calculated. The differential cross section and the average value of the spin represent the specific cases of zero and first-order Fano tensors. As an application of the theoretical derivation, the elastic scattering of particles with $3/2$ spin, such as ^{7}Li, ^{9}Be, ^{11}B, etc., was examined by means of the Racah formalism. Using the Eckart-Wigner theorem, a formula was obtained for determining the symmetry properties of tracks. 46 references. (TTT)

9985 ON THE 1-FORBIDDEN M 1 TRANSITION OF ^{147}Pm. Ayyangar, K. M. M. S.; Lakshminarayana, V.; Jnanananda, Swami (Andhra Univ., Waltair, India). Curr. Sci. (India), 34: 606-7(Nov. 5, 1965).

The 91-kev transition resulting from the $d_{5/2}$ to the $g_{7/2}$ states in the promethium-147 nucleus was measured with a time-to-amplitude converter in order to compare the experimental transition probability with that calculated using the formula of Arima. Neodymium-147 is obtained as neodymium chloride in dilute HCl with an activity of 6 mC in 8 cc. A beta-gamma coincidence experiment was carried out for the determination of the lifetime of the 91-kev level. The experimental results are shown, and the

half life of 2.49 ± 0.12 nsec was obtained. The experimental transition probability is also obtained. (J.F.P.)

9986 ASYMMETRY AND ANGULAR ANISOTROPY OF MASS DISTRIBUTIONS OF THE FRAGMENTS PRODUCED BY FISSION OF ^{238}U WITH 14-Mev NEUTRONS. Komar, A. P. (Ioffe Inst. of Physics and Tech., Leningrad); Bochagov, B. A.; Fadeev, V. I. Dokl. Akad. Nauk SSSR, 163: 71-3 (July 1, 1965). (In Russian).

It was previously observed that the mass distribution of the fragments of ^{238}U nuclei fissioned by 14-Mev neutrons exhibits a dependence on the angle between the neutron beam and the fragment direction. This earlier data as well as data by others were used to determine the yields of the fission fragments of ^{239}U, ^{238}U, and ^{237}U. On the basis of the known contributions made by the fission of these nuclei to the total yield and to their anisotropy, the relative yields of the fragments were plotted for the case of fission of ^{238}U by 14-Mev neutrons. The calculated results agree well with the experiment. It is concluded on this basis that the theoretically calculated result that the yield of fragments with ratio of the mass of the heavy fragment to that of the light fragment (R) ≥ 1.45 in the direction of the neutron beam increases noticeably, and also the deduced connection between R and the anisotropy, are not affected by the simplifying assumptions made in the calculations. (ATD)

9987 THE T(d,n)^{4}He REACTION AT LOW ENERGIES. Goldfarb, L. J. B.; Huq, A. (The Univ., Manchester, Eng.). Helv. Phys. Acta, 38: 541-50(Oct. 1965).

A crude model is given of the mechanism of the d + t → α + n reaction, for E_d = 500 kev, which includes the effect of the resonance observed at E_d = 107 kev together with a contribution from a stripping mode. Comparison is made with the observed differential cross sections and the angular distributions associated with a polarized deuteron beam where the latter is described by different values of P_{33}, $P_{11} - P_{22}$, and P_2. (auth)

9988 CALCULATIONS OF MOMENTS OF INERTIA OF EXCITED NUCLEI. Safarov, R. Kh. Izv. Akad. Nauk Uz. SSR, Ser. Fiz.-Mat. Nauk, No. 1, 86-92(1965). (In Russian).

Changes in the moments of inertia of the various states of even-even and odd nuclei can be calculated on the basis of Solov'ev's superfluidity model of the nucleus which takes into account the residual interaction of the superconducting type nucleons. To eliminate the uncertainty due to the sufficient knowledge of the levels, the same fixed-level system is used for a whole series of nuclei. The wave function changes are neglected, and the deformation is assumed to be constant (δ = 0.2). The series of equations was solved by iteration on the computer. Good agreement was obtained with experimental data for odd nuclei, with the exception of ^{161}Dy, ^{169}Tm, and ^{177}Hf. In view of the spin splitting of even-even nuclei, which is not sufficiently considered by the superfluidity model, it is difficult to make direct comparison for that class of nuclei. However, the experimental value of this factor is 10 to 20%, and the calculated values agreed with the experimental data within the same limits, except for ^{160}Dy and ^{178}Hf. (TTT)

9989 AN APPROXIMATE METHOD FOR EVALUATING NEUTRON CAPTURE IN THE ^{240}Pu RESONANCE AT 1 ev. Griggs, C. F. (United Kingdom Atomic Energy Authority, Windscale, Eng.). J. Nucl. Energy. Pt. A and B, 19: 891-905(Nov. 1965). (TRG-Report-778).

A method for treating the 1-ev resonance of ^{240}Pu is outlined, and some results obtained with the PLUTOX program, which is based on the method for a plutonium-enriched AGR-type lattice cell with a smeared cylindrical fuel region, are presented. (D.C.W.)

9990 CROSS SECTIONS FOR THE REACTIONS ^{55}Mn(n,2n)^{54}Mn, ^{59}Co(n,2n)^{58}Co, ^{24}Mg(n,p)^{24}Na, AND ^{27}Al(n,α)^{24}Na IN THE 12.6–19.6 Mev ENERGY REGION. Paulsen, A.; Liskien, H. (Central Bureau for Nuclear Measurements, Euratom, Geel, Belg.). J. Nucl. Energy: Pt. A and B, 19: 907-11(Nov. 1965).

The cross sections for the reactions ^{55}Mn(n,2n)^{54}Mn, ^{59}Co(n,2n)^{58}Co, ^{24}Mg(n,p)^{24}Na, and ^{27}Al(n,α)^{24}Na were determined in the energy range from 12.6 to 19.6 Mev. (G.O.Y.)

9991 ANGULAR DISTRIBUTIONS OF α PARTICLES FROM THE REACTIONS ^{12}C(d,α)^{10}B AND ^{16}O(d,α)^{14}N. Dolinov, V. K.; Melikov, Yu. V.; Tulinov, A. F. (Moscow State Univ.). JETP Lett. (USSR) (Engl. Transl.), 2: 74-6 (Aug. 1, 1965).

The reactions ^{12}C(d,α)^{10}B and ^{16}O(d,α)^{14}N were investigated at two values of the deuteron energy, 11.4 and 12.4 Mev. The angular distributions of four groups of alpha particles from the reaction of deuterons on carbon-12 corresponding to the ground and three excited states (0.72, 2.15, and 3.58 Mev) of boron-10, and two groups of alpha particles from the reaction of deuterons on oxygen-16 corresponding to the ground and second-excited state (3.94 Mev) of nitrogen-14 are shown. The characteristic peculiarities of the angular distributions, and the relatively weak dependence of the distribution on the deuteron energy, indicate that the direct interaction plays a predominant role. (J.F.P.)

9992 ISOTOPIC STRUCTURE OF PARITY NONCONSERVING NUCLEAR FORCES. Dal'karov, O. D. JETP Lett. (USSR) (Engl. Transl.), 2: 124-6(Aug. 15, 1965).

The possible contribution made to the asymmetry, relative to the plane of polarization of the incident radiation, of nucleon emission in the γ + d → n + p reaction by the static isovector part of the weak internucleon interaction is estimated. (J.F.P.)

9993 PICKUP OF A DEUTERON AND AN α PARTICLE IN THE INTERACTION BETWEEN ^{10}B AND ^{16}O. Shumilov, S. N.; Klyucharev, A. P.; Rutkevich, N. Ya. (Physico-Technical Inst., Academy of Sciences, Ukrainian SSR). JETP Lett. (USSR) (Engl. Transl.), 2: 135-6(Sept. 1, 1965).

A large number of four-pronged stars was observed in a study of the interaction between boron-10 ions at 100 Mev and emulsion nuclei, three of the prongs being tracks of alpha particles and the fourth the track of a heavier particle. There were 252 stars identified due to the reaction $^{16}O + {}^{10}B \rightarrow {}^{14}N + 3\alpha + 2.8$ Mev. The excitation function for this reaction is shown. The angular distribution of the ^{14}N nuclei in the cms system is also shown. The ^{12}C nucleus produced when the ^{16}O nucleus loses the alpha particle remains in the excited state and dissociates into three alpha particles principally via the ground and first-excited states of ^{8}Be. Not a single case of the oxygen-16–boron-10 reaction was found when the energy of the bombarding ions was less than 25 Mev. (J.F.P.)

9994 EXCHANGE EFFECT IN ELASTIC SCATTERING OF POLARIZED IDENTICAL NUCLEI. Dalidchik, F. I.; Sayasov, Yu. S. (Inst. of Chemical Physics, Academy of Sciences, USSR). JETP Lett. (USSR) (Engl. Transl.), 2: 169-71(Sept. 15, 1965).

The problem of elastic scattering of Coulomb-interacting polarized identical particles is considered. It is found that in the general case the intensity of the oscillations of the exchange term depends essentially on the degree of polarization of the beam and of the target. This can serve as a basis for a new method of detecting polarization of slow charged particles. (J.F.P.)

9995 ON THE SHAPE OF ODD NUCLEI OF THE TRANSITION REGION. Berlovich, E. E.; Novikov, Yu. N. (Ioffe Physico-Technical Inst., Academy of Sciences, USSR). JETP Lett. (USSR) (Engl. Transl.), 2: 179-81(Sept. 15, 1965).

The equilibrium deformations of odd-proton nuclei were calculated by the method of Mottelsson and Nilsson (Mat.-fys. Dan. Vid. Selskab, 1: No. 8 (1959)). The pairing forces were not included in the calculations. The properties of M1 and E2 transitions are listed. It is concluded that the odd-neutron nuclei of the transition region are spherical; only for N = 89 does the shape become ellipsoidal. The properties of odd-neutron nuclei can be described by the phonon model with pairing. These nuclei have small equilibrium deformations, which increase gradually with increasing number of neutrons, up to N = 88. On going from N = 88 to

N = 90, the deformation increases more abruptly. This refutes the opinion that the transition of the nuclear shape from spherical is always abrupt. (J.F.P.)

9996 INELASTIC SCATTERING OF 95 kev NEUTRONS FROM THE 45 kev LEVEL IN ^{238}U. Stroemberg, L. G.; Schwarz, S. (Research Inst. of National Defence, Stockholm). Nucl. Phys., 71: 511-22(Sept. 1965).

The cross section for inelastic scattering from the first excited (rotational) level in ^{238}U was studied for 95 kev incident neutron energy. The experiment was performed by the time-of-flight method with a ^{6}Li glass scintillation detector. The result obtained is ≈60 mb with a statistical error of ≈150 mb. This should be compared to the cross section of ≈450 mb expected from statistical model calculations based on experimental results obtained at higher energies. (auth)

9997 KINETIC ENERGY OF FRAGMENTS AND ENERGY BALANCE IN THE FISSION OF ^{235}U BY THERMAL NEUTRONS. Apalin, V. F.; Gritsyuk, Yu. N.; Kutikov, I. E.; Lebedev, V. I.; Mikaelian, L. A. (Kurchatov Atomic Energy Inst., Moscow). Nucl. Phys., 71: 546-52(Sept. 1965).

The distribution of the total kinetic energy of additional fragments as a function of their mass ratio is measured with a gas ionization chamber. The difference between the average kinetic energies in symmetrical fission and the fission in which the heavy fragment is "magic" (M_T = 130 to 132) is found to be 21 Mev. The maximum-minimum ratio for the yield curve of (final) fragments in symmetrical fission was 500:1 in these measurements. The total energy yield found by experimental data is in good agreement with predictions by the semi-empirical Weizsäcker formula everywhere except in the strongly asymmetrical fission region. (auth)

9998 NEUTRON EMISSION FROM ^{233}U, ^{235}U AND ^{239}Pu FISSION FRAGMENTS. Apalin, V. F.; Gritsyuk, Yu. N.; Kutikov, I. E.; Lebedev, V. I.; Mikaelian, L. A. (Kurchatov Atomic Energy Inst., Moscow). Nucl. Phys., 71: 553-60(Sept. 1965).

Quantitative data on neutron emission in the symmetrical fission region are obtained. The number of spurious events registered in this region was reduced to 15–20%. (auth)

9999 THE PHOTOFISSION OF ^{238}U. Hogg, G. R. (Univ. of Melbourne). Nucl. Phys., 72: 167-76(Oct. 1965).

The fragment mass yield distributions from the photofission of ^{238}U induced by 33 Mev bremsstrahlung were measured for various ranges of total fission fragment kinetic energy release. The fragment energies were detected with semiconductor detectors and the fragment mass obtained by the analysis of the coincident energies with an analog ratio circuit. The variations of the most probable mass ratio m_H/m_L and of the symmetric mass yield, with average total fragment energy release, are discussed in terms of the fragment shell theory and the two mode hypothesis. The data are consistent with both theories. (auth)

10000 ANGULAR DISTRIBUTION OF NEUTRONS FROM THE ^{55}Mn(α,n)^{58}Co REACTION AT E_α = 14 AND 17 Mev. Alevra, A.; Dumitrescu, R.; Lukas, I. R.; Magda, M. T.; Martalogu, N.; Plostinaru, D.; Poenaru, D.; Trutia, E.; Vilcov, I.; Vilcov, N. (Inst. for Atomic Physics, Bucharest). Nucl. Phys., 72: 209-17(Oct. 1965).

The angular distribution of neutrons from the ^{55}Mn(α,n) ^{58}Co reaction was measured at two bombarding energies E_α = 14 and 17 Mev and for various intervals of the excitation energy E* in the residual nucleus ^{58}Co. The angular distribution in the range E* = 1–4 Mev shows a forward peak, indicating a direct interaction contribution to the reaction. The angular distributions in the ranges E* = 4–5 Mev, 5–6 Mev and 6–7 Mev were treated in the frame of the compound nucleus statistical theory and were used to calculate the ratio $\mathcal{R} = \mathcal{I}/\mathcal{I}_{rigid}$ for ^{58}Co. The data are completed by the angular distribution of the apparent temperature of the ^{58}Co nucleus. (auth)

10001 THE SPECTRUM OF THE MAIN BETA TRANSITION OF ^{198}Au AND THE K CONVERSION COEFFICIENT OF THE 412 kev GAMMA TRANSITION. Paul, Helmut (Reaktorzentrum, Seibersdorf, Austria). Nucl. Phys., 72: 326-36(Oct. 1965).

Using a thoroughly tested Siegbahn-Slätis intermediate-image spectrometer, the shape factor of the 961 kev beta transition was measured and found to be 1 – (0.031 ± 0.006) W. This result is based on the Fermi function by Dzhelepov and Zyrianova. The end-point energy is 961.0 ± 1.2 kev. By comparing the area under the K conversion line of the 412 kev transition in ^{198}Hg to that under the continuous spectrum, the K conversion coefficient was determined to be (299 ± 2) × 10^{-4}, in very good agreement with the theoretical value for a E2 transition. (auth)

10002 NUCLEAR STRUCTURE EFFECT IN THE 57.1 kev M1 TRANSITION OF A ROTATIONAL BAND IN ^{161}Dy. Subba Rao, B. N. (Tata Inst. of Fundamental Research, Bombay). Nucl. Phys., 72: 414-16(Oct. 1965).

Earlier angular correlation data (Nuovo Cimento, 23: 477 (1962)) are reinterpreted, with the aid of L_I/L_{III} subshell ratios, together with the nuclear structure effect on the L_I conversion coefficient of the 57.1-kev transition. This results in a $5/2^- \rightarrow 3/2^- \rightarrow 5/2^+$ sequence for the 57.1 kev → 74.5 kev cascade, $\delta_{57.1} = -0.22$ and $\delta_{74.5} = +0.05$, and with $L_I/L_{III} = 4.3$, $\lambda = -7$ for L_I internal conversion. (auth)

10003 ENERGY LEVELS IN ^{57}Fe. Mathiesen, J. M.; Hurley, J. P. (Naval Radiological Defense Lab., San Francisco). Nucl. Phys., 72: 475-80(Oct. 1965).

The energies and intensities of the gamma rays from ^{57}Fe were measured using a high resolution Ge(Li) detector. Nine gamma rays were detected at energies of 14, 123, 137, 340, 353, 367, 570, 693, and 707 kev. Relative intensities of these transitions were also determined from these measurements. An energy level scheme is proposed and discussed. (auth)

10004 INVESTIGATION OF THE SPECTRA OF CONVERSION ELECTRONS AND POSITONS OF THE Nd FRACTION NEW ISOTOPE ^{137}Nd. Gromov, K. (Joint Inst. for Nuclear Research, Dubna, USSR); Kalinnikov, V.; Kuznetsov V.; Lebedev, N.; Musiol, G.; Herrmann, E.; Zhelev, Zh.; Dzhelepov, B.; Kudryavtseva, A. Nucl. Phys., 73: 65-73 (1965).

Targets of Ta and Er were irradiated with a proton beam from the Dubna synchrocyclotron. The conversion electrons and the positrons of the Nd spallation fraction were studied using beta spectrometer. A new activity with a half life of 55 ± 1.5 min was observed. It is established that this activity is due to the decay of ^{137}Nd to ^{137}Pr. A decay scheme is proposed. (auth)

10005 A STUDY OF THE EXCITED STATES OF ^{127}I POPULATED IN THE DECAY OF ^{127}Te AND ^{127m}Te. Auble, R. L.; Kelly, W. H. (Michigan State Univ., East Lansing). Nucl. Phys., 73: 25-32(Nov. 1965).

Gamma ray singles, coincidence and angular correlation studies were performed to aid in determination of the spins of several excited states in ^{127}I and the multipolarities of the gamma ray transitions from these states. The results, when analysed in conjunction with other recent findings, allow unique spin assignments of 5/2, 7/2, 3/2 and 5/2 to be made for the ground, 0.0576, 0.203 and 0.417 Mev states, respectively. In addition, a state at 0.649 Mev has been observed which had been unreported in previous studies. The close similarity between these states and those in ^{121}Sb is noted. (auth)

10006 MEASUREMENTS OF THE ^{54}Fe(n,p)^{54}Mn REACTION CROSS SECTION IN THE NEUTRON ENERGY RANGE 2.3-3.8 Mev. Lauber, Alexander; Malmskog, Sven G. (AB Atomenergi, Studsvik, Sweden). Nucl. Phys., 73: 234-40(Nov. 1965).

The ^{54}Fe(n,p)^{54}Mn reaction cross section was measured using a surface barrier detector to record the number of protons released in the reaction. The neutron flux was determined by means of a hydrogenous radiator, detecting the scattered protons with the solid state detector and cal-

culating the number of impinging neutrons from the well-known cross section. The $^{54}Fe(n,p)^{54}Mn$ reaction cross section is found to increase from 25 mb at 2.3 Mev to 208 mb at 3.6 Mev. (auth)

10007 INELASTIC SCATTERING OF 14 Mev NEUTRONS. Shectman, Richard M.; Anderson, John D. (Univ. of California, Livermore). Nucl. Phys., 77: 241-53(1966).

The inelastic scattering of 14 Mev neutrons from natural samples of Al, Fe, Ni, Cu, Cd, Sn, Pb, and Bi was studied using a neutron time-of-flight facility. For each sample the absolute differential cross sections, $\sigma(\theta,E)$, were measured at laboratory angles of 60, 90, and 120°. For the low-energy neutron spectra ($1 < E_n < 5$ Mev), many of the features observed were qualitatively in accordance with predictions of the statistical model. Quantitative comparison, however, required extending the statistical model to describe multiple neutron emission, and the agreement was not satisfactory, independent of the choice of level density parameters. (auth)

10008 THE REACTIONS $^{12}C(^3He,\alpha)^{11}C$ AND $^{12}C(^3He,p)^{14}N$. Blake, R. S.; Jacobs, D. J.; Newton, J. O.; Schapira, J. P. (Univ. of Manchester, Eng.). Nucl. Phys., 77: 254-66(1966).

Excitation functions at lab angles of 15, 55, 125, and 165° were measured for the reactions $^{12}C(^3He,\alpha)^{11}C$ leading to the ground and first excited state (excluding 15°) of ^{11}C in the range of bombarding energy from 2.0 to 6.2 Mev. At the same four angles excitation functions taken in the energy range 4.0 to 6.0 Mev were measured for the reactions $^{12}C(^3He,p)^{14}N$, leading to the states at 3.99, 4.91, 5.10, 5.69, and 5.83 Mev in ^{14}N. Angular distributions of the ground state alpha particle group were measured at 14 energies between 4.85 and 5.89 Mev. In the vicinity of 5.63 Mev bombarding energy the angular distribution is strongly peaked in the backward direction. Four angular distributions were obtained for the alpha group to the first excited state in the same region of energy. An angular distribution at 5.05 Mev bombarding energy for each of the proton groups was measured. The results are discussed. (auth)

10009 GAMMA-GAMMA ANGULAR CORRELATION MEASUREMENTS IN THE $^{35}Cl(n,\gamma)^{36}Cl$ REACTION. van Middelkoop, G.; Spilling, P. (Rijksuniversiteit, Utrecht). Nucl. Phys., 77: 267-75(1966).

With scintillation spectrometers, angular correlations were measured of γ radiation following thermal neutron capture in ^{35}Cl. The following spins in ^{36}Cl are determined: J(0.788) = 2 or 3, J(1.949) = 2, J(1.957) = 2, J(2.469) = 3. The latter three spin assignments are based on the assumption that the 2.469 → 1.949 Mev transition has E1 character. The capturing state is predominantly of J = 2 character. (auth)

10010 THE COMPOUND NUCLEUS PROCESS IN (n,α) REACTIONS ON ^{31}P, ^{32}S AND ^{40}Ca. Turkiewicz, I. M. (Inst. of Nuclear Research, Warsaw); Cindro, N.; Kulisic, P.; Strohal, P.; Veselic, D. Nucl. Phys., 77: 276-88(1966).

The spectra and angular distributions of alpha particles from (n,α) reactions on ^{31}P, ^{32}S, and ^{40}Ca were measured by a telescope technique with a two-parameter analysis of pulses from ΔE and E counters. The results were used to calculate the values of the nuclear density parameters a and $2\sigma^2$ in the frame of the compound nucleus theory. The obtained values of a were 3.7, 4.0, and 3.5 for ^{28}Al, ^{29}Si, and ^{37}Ar, respectively. Very good agreement of the shape of experimental spectra with the theoretical energy distribution was observed. The total cross sections for (n,α) reactions proceeding via a compound process were estimated for ^{31}P (91 mb) and ^{32}S (88 mb). The cut-off parameter $2\sigma^2$ was estimated to be 5.1 for ^{31}P and 5.5 for ^{32}S. (auth)

10011 ANALYTIC THEORY OF SUBCOULOMB STRIPPING. Morinigo, Fernando B. (Univ., Freiburg i. B.). Nucl. Phys., 77: 289-97(1966).

It is suggested that an expansion of a general stripping amplitude into a pure Coulomb wave part plus Legendre-polynomial corrections may be the simplest and most efficient way to extract useful information, that is, L values and reduced widths, from stripping cross sections. The method is expected to be most useful in applications to reactions of low Q value measured at bombarding energies below the Coulomb barrier. The idea of the analysis is similar to that used in elastic scattering, in which the scattering amplitude is expressed as a pure Rutherford amplitude plus a sum of Legendre polynomials. At low bombarding energies, it is likely that corrections from wave distortions other than Coulomb, due to exchange terms, heavy-knock-out contributions, compound-nucleus effects, finite range effects, or virtual excitations such as electrical polarizations, may be suitably represented by a small number of terms in a Legendre polynomial expansion. The theoretical curves for a hypothetical (d,n) reaction of L = 0, in a case in which only an isotropic correction is important, are presented in detail. It is found that the curves show many characteristics present in available data, which are not suitably explained by other models of stripping. An experimental study of the energy dependence of the parameters of this theory should serve to disentangle the relative importance of the various corrections and might yield new information not available when stripping cross sections are analyzed in terms of the conventional Butler or DWBA theories. (auth)

10012 MEASUREMENT OF THE g-FACTOR OF THE 204 kev LEVEL OF ^{95}Mo. Andrade, P. Da R.; Maciel, Alice; Rogers, J. D.; Wirth, J.; Zawislak, F. C. (Univ. do Rio Grande do Sul, Porto Alegre, Brazil). Nucl. Phys., 77: 298-304(1966).

The g factor of the 204 kev level in ^{95}Mo was measured by the rotation of the angular correlation pattern in an external magnetic field. The result obtained is $g = -0.36 \pm 0.04$. The result is compared to the predictions of different models. (auth)

10013 A STUDY OF THE SCATTERING OF 145 Mev PROTONS FROM CARBON USING SPARK CHAMBERS. Emmerson, J. McL.; Madden, J. C. W.; Johnson, C. M. P.; Middlemas, N.; Clegg, A. B.; Williams, W. S. C. (Nuclear Physics Lab., Oxford). Nucl. Phys., 77: 305-31(1966).

Measurements were made of the differential cross sections for scattering 145 Mev protons from ^{12}C through angles in the range 20 to 140° and of the asymmetries in scattering polarized protons through angles in the range 20 to 85°. Results are given for elastic scattering, for scattering from the states at 4.4 and 9.6 Mev, and for scattering from groups of states in the ranges 14 ± 2.25 Mev and 18.5 ± 2.25 Mev. Data were taken in 2.9° angular bins. The results are in good agreement with previous measurements in the range of overlap. (auth)

10014 ON THE DISTORTION OF THE ^8Be CLUSTER MODEL WAVE FUNCTION. Webber, John C. (Computing Devices of Canada, Ottawa). Nucl. Phys., 77: 332-6(1966).

The distortion of the ^8Be cluster model wave function is investigated through the determination of the rms alpha cluster radius and separation as a function of the model width parameters. Because of the indistinguishability of the nucleons, these quantities provide an estimate of the alpha clustering described by the cluster model. (auth)

10015 EXCITATION FUNCTIONS OF THE REACTIONS INDUCED BY 23 TO 52 Mev ALPHA PARTICLES ON ^{197}Au. Vinciguerra, D. (Instituut voor Kernphysisch Onderzoek, Amsterdam. Univ., Catania, Italy); Kotajima, K.; Van De Vijver, R. E. Nucl. Phys., 77: 337-46(1966).

The cross sections for the reactions induced by alpha particles on Au from 23 to 52 Mev were measured. The results for the (α,xn) reactions are compared with statistical calculations. The theoretical curves are in agreement with the experiment with a value $a = 18$ Mev^{-1} for the level density parameter. (auth)

10016 ISOMERIC CROSS SECTION RATIO FOR THE $^{197}Au(\alpha,2n)$ AND $^{197}Au(\alpha,4n)$ REACTIONS. Vinciguerra, D. (Instituut voor Kernphysisch Onderzoek, Amsterdam.

Istituto di Fisica, Catania, Italy); Kotajima, K. Nucl. Phys., 77: 347-56(1966).

The isomeric cross section ratio $R = \sigma_m/\sigma_g$ for the reactions $^{197}Au(\alpha,2n)^{199g,m}Tl$ and $^{197}Au(\alpha,4n)^{197g,m}Tl$ was determined by measuring the de-excitation gamma rays of the final nucleus in both prompt and delayed coincidence with the beam bursts. The excitation function of the two reactions was obtained and is compared with a previous measurement. A calculation of the isomeric cross section ratio following the method of Vandenbosch and Huizenga indicates a value $\sigma \approx 3$ for the cut-off parameter of the spin dependence of the nuclear level density. (auth)

10017 MULTIPOLE INTERACTIONS IN HIGH-ENERGY ELECTRON SCATTERING BY NUCLEI. **Wadia, Wahby; Youssef, M. (Atomic Energy Establishment, Cairo). Nucl. Phys., 77: 357-64(1966).**

A direct method is presented for the multipole expansion of the interaction of the relativistic plane wave electron field with the nucleus. The method makes clear the meaning and significance of the different multipole types. (auth)

10018 LEVEL STRUCTURE MEASUREMENTS WITH THE (p,α) REACTION. I. ENERGY LEVELS IN ^{51}Mn, ^{53}Mn AND ^{56}Fe. **Brown, G. (Bradford Inst. of Tech., Eng.); Warren, S. E.; Middleton, R. Nucl. Phys., 77: 365-84(1966).**

Data on the positions of the energy levels of ^{51}Mn, ^{53}Mn, and ^{56}Fe were obtained from a study of the reactions $^{54}Fe(p,\alpha)^{51}Mn$, $^{56}Fe(p,\alpha)^{53}Mn$, and $^{59}Co(p,\alpha)^{56}Fe$. A comparison of the $^{56}Fe(p,p')^{56}Fe$ and $^{59}Co(p,\alpha)^{56}Fe$ reactions shows that the two reactions generally lead to the observation of the same levels except in regions where the resolution in the (p,α) reaction is insufficient to separate closely spaced levels. (auth)

10019 LEVEL STRUCTURE MEASUREMENTS WITH THE (p,α) REACTION. II. ENERGY LEVELS OF ^{47}V AND ^{49}V. **Brown, G. (Bradford Inst. of Tech., Eng.). Macgregor, A.; Middleton, R. Nucl. Phys., 77: 385-93 (1966).**

Data on the positions of energy levels in ^{47}V and ^{49}V were obtained from a study of the reactions $^{50}Cr(p,\alpha)^{47}V$ and $^{52}Cr(p,\alpha)^{49}V$. The data on the level positions of ^{49}V are compared with those for ^{51}V and ^{53}V to obtain evidence for the effect on nuclear level density of holes in and particles outside a closed shell. (auth)

10020 THE DECAY OF ^{32}Cl AND ^{40}Sc AND THE T = 1 ISOBARIC ANALOGUE STATES IN ^{32}S AND ^{40}Ca. **Anderson, W. C.; Dillman, L. T.; Kraushaar, J. J. (Univ. of Colorado, Boulder). Nucl. Phys., 77: 401-24(1966). (UCOL-535-547).**

Gamma rays following the decay of 0.30-sec ^{32}Cl and 0.18-sec ^{40}Sc were studied, using NaI scintillation counters and a lithium-drifted germanium detector. Seven gamma rays were identified, both in the case of ^{32}Cl and ^{40}Sc. By the construction of decay schemes through the help of coincidence studies, the positions of the lowest T = 1 isobaric analog states were determined to be at 7.014 ± 0.010 Mev in ^{32}S and 7.646 ± 0.009 Mev in ^{40}Ca. The endpoint energy of the positron branch to the 2.24-Mev level in ^{32}S was determined to be 9.46 ± 0.09 Mev, and the branch to the 4.48-Mev level in ^{40}Ca to be 9.10 ± 0.09 Mev. (auth)

10021 A THEORETICAL STUDY OF THE BETA DECAY OF ^{40}Sc. **Kunz, P. D. (Univ. of Colorado, Boulder). Nucl. Phys., 77: 425-34(1966). (UCOL-535-548).**

The positron decay of ^{40}Sc to the negative-parity states of ^{40}Ca is studied using the results of an intermediate-coupling shell-model calculation for the wave functions of the ^{40}Sc ground state and ^{40}Ca excited states. The branching ratios for the decay to the various levels in ^{40}Ca and the resulting M1 gamma-ray transition rates between the negative parity states in ^{40}Ca are calculated using these wave functions. The theoretical results are compared with experiment. (auth)

10022 SUMMATION OF SELECTED SEQUENCES OF GRAPHS IN THE THEORY OF NUCLEAR REACTIONS. **Tsekhmistrenko, Yu. V. (Inst. of Physics, Ukrainian Academy of Sciences, Kiev). Nucl. Phys., 77: 435-48 (1966).**

Two types of graphs are summed: (a) ladder graphs under the assumption that $m_n/m_a \ll 1$ (m_n is the mass of the incident and m_a that of the target nucleus) and (b) complex graphs consisting of recurrent blocks of two types under the assumption that the summation of blocks of one type gives a Yamaguchi amplitude and the sum of blocks of the other type gives a known result. The analytical properties of the amplitudes obtained are investigated and discussed. In particular it is shown that complex poles which must be interpreted as Breit-Wigner poles are bound to arise in case (b). (auth)

10023 TOTAL CROSS SECTIONS FOR THE REACTION $^{12}C(^3He,\alpha)^{11}C$ AND $^{12}C(^3He,n)^{14}O$. **Cirilov, S. D.; Newton, J. O.; Schapira, J. P. (Univ. of Manchester, Eng.). Nucl. Phys., 77: 472-6(1966).**

The reactions $^{12}C(^3He,\alpha)^{11}C$ and $^{12}C(^3He,n)^{14}O$ were studied in the energy range from 1.4 to 6.0 Mev by an activation method. Excitation functions and absolute cross sections were measured. (auth)

10024 ENERGY GAP IN SPHERICAL NUCLEI. **Thompson, Colin J.; Waghmare, Yeshwant R. (Univ. of California, San Diego, La Jolla). Nucl. Phys., 77: 477-80(1966).**

The superconducting energy gap equation for a sphere of radius a and for a delta function interaction is solved, and the results are compared with observed nuclear pairing energies by choosing a so that the volume of the sphere is the same as that of the given nucleus. (auth)

10025 THE THERMAL-NEUTRON-ACTIVATION CROSS SECTION OF ^{59}Co. **Vaninbroukx, R. (EURATOM, Geel, Belg.). Nucl. Sci. Eng., 24: 87-8(Jan. 1966).**

Thin spectroscopically pure foils of cobalt and gold were irradiated simultaneously in the thermal column of the BR1 reactor. The activities of the foils were measured with a calibrated γ-spectrometer and a $4\pi B$-γ coincidence counter, and the ratio of the cross sections were determined from the ratio of activities. The mean value from all measurements for the thermal-neutron activation cross section of ^{59}Co was found to be 37.4 b. (L.B.S.)

10026 SOME REMARKS ABOUT STABILITY CONDITIONS FOR THE SOLUTIONS OF THE HARTREE-BOGOLYUBOV EQUATIONS IN THE CASE OF A CHARGE-INDEPENDENT PAIRING FORCE BETWEEN NUCLEONS. **Camiz, P. (Univ., Rome). Nuovo Cimento (10), 40A: 1220-3(Dec. 21, 1965).**

Three types of solutions were found previously for the Hartree-Bogolyubov equations for a system of nucleons in a single-j shell, interacting through a charge-independent pairing force. Solution A corresponds to a product of two ordinary Bogolyubov transformations operating separately upon neutrons and protons and is completely symmetrical in the quasiparticle space. Solution B mixes neutrons and protons but is not symmetrical in the quasiparticle space. Solution C is more general, allowing the average value of T^2 to be chosen. Stability conditions for these solutions, i.e., conditions that the solutions of the variational problems correspond to a minimum for the ground-state energy, are studied. It is found that solution A is stable, solution B is not stable, and solution C is stable when the assigned average value of T_z is restricted to a domain closest to $T_z = 0$ when the shell degeneracy is lowest. (M.J.T.)

10027 TREATMENT OF PAIRING CORRELATIONS WITHOUT VIOLATION OF CONSERVATION LAWS. **Jean, M. (Institut de Physique Nucleaire, Orsay, France). Nuovo Cimento (10), 40A: 1224-7(Dec. 21, 1965).**

A reformulation is suggested of an approximation method for treating pairing correlations in nuclei, which brings the method close to the Hartree-Bogolyubov formalism and is capable of further systematic generalization. A shell-model hamiltonian with a residual interaction is considered, and equations are obtained for the amplitudes of interactions of A nucleons, satisfying orthonormality conditions and particle-number conservation. An approximation method for solving these equations is found for the

case of identical particles interacting through a pairing potential. (M.J.T.)

10028 THE DECAY SCHEME OF ^{95}Ru. Riehs, Peter; Warhanek, Hans. Oesterr. Akad. Wiss., Math.-Naturwiss. Kl., Anz., 101: 191-4(1964). (In German).

The decay scheme of ^{95}Ru, prepared by (n,2n) processes with 14-Mev neutrons, was determined using a NaI(Tl) crystal, γ-γ coincidence measurements, and β measurements. A previously unknown γ transition at 1430 kev was detected. In addition, γ lines at 295, 870, and 1180 were assumed. The coincidence of the lines at 340 and 1090 kev was established. It was established that the transition of ^{95}Ru to ^{95}Tc leads at least 80% to the ground state and not to the 60-day isomer. A β component with a maximum energy of 1010 ± 30 kev, coincident with the γ line at 340 kev, was established. A proposed decay scheme is given. (J.S.R.)

10029 SEARCH FOR DOUBLE-PHOTON DECAY IN ^{90}Zr. Vanderleeden, J. C.; Jastram, P. S. (Ohio State Univ., Columbus). Phys. Lett., 19: 27-9(Sept. 15, 1965).

An attempt was made to detect the double-photon decay of ^{90}Zr from the 1.762-Mev state by studying the decay of ^{90}Sr. A slow-fast coincidence spectrometer with a resolving time of 9.4 nsec was used. The sum spectra were found to be continuous and to extend beyond 1.762 Mev. (G.O.Y.)

10030 DOUBLE INTERNAL BREMSSTRAHLUNG IN THE BETA DECAY OF ^{90}Y AND ^{32}P. Jastram, P. S.; Vanderleeden, J. C. (Ohio State Univ., Columbus). Phys. Lett., 19: 29-32(Sept. 15, 1965).

The beta decay of ^{90}Y was studied in an attempt to explain the continuous three-dimensional coincidence spectrum observed in ^{90}Y → ^{90}Zr decay. The beta decay of ^{32}P was used for an independent check of the ^{90}Y data. The data were analyzed in terms of double internal bremsstrahlung. The experimental results for ^{90}Y agree in magnitude, energy dependence, and angular correlation with theoretical results for double internal bremsstrahlung, while the results for ^{32}P agree only in order of magnitude. (D.C.W.)

10031 EVIDENCE FOR THE EXCITATION OF DOUBLE ANALOGUE STATES IN (p,n) REACTIONS. Batty, C. J. (Rutherford High Energy Lab., Chilton, Eng.); Friedman, E.; Rowe, P. C.; Hunt, J. B. Phys. Lett., 19: 33-5(Sept. 15, 1965).

The possibility of observing double analog states in (p,n) reactions was studied by recording the neutron spectra from proton reactions with ^{59}Co and ^{90}Zr at 30 and 50 Mev. The Q-values for the double analog states were determined and were compared with theoretical values. It was concluded that double analog states can be observed in (p,n) reactions. (D.C.W.)

10032 ENERGY LEVELS OF ^{6}Be AND ^{7}Be OBSERVED IN (p,n) REACTIONS. Batty, C. J. (Rutherford High Energy Lab., Chilton, Eng.); Friedman, E.; Rowe, P. C.; Hunt, J. B. Phys. Lett., 19: 35-7(Sept. 15, 1965).

The energy levels of ^{6}Be and ^{7}Be were investigated by measuring the neutron spectra from (p,n) reactions on ^{6}Li and ^{7}Li at 30.64 and 49.4 Mev over a range of angles. (G.O.Y.)

10033 COHERENT EFFECTS IN NUCLEON CLUSTER SUBSTITUTION REACTIONS. Boyarkina, A. N.; Atti, C. Ciofi Degli (Moscow State Univ.). Phys. Lett., 19: 38-41(Sept. 15, 1965).

The cross section for the ^{14}N(^{3}He,α)^{13}N reaction was calculated taking into account the Young scheme mixing configuration of the nuclear states. The results confirm the view that the cluster substitution mechanism plays a very important (possibly determining) role in direct interactions with complex particles at low and medium energies. (D.C.W.)

10034 COMPOUND ELASTIC CROSS SECTION IN ^{56}Fe(p,p$_0$) AT ABOUT 10 Mev PROTON ENERGY. Ernst, J.; Von Brentano, P.; Mayer-Kuckuk, T. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Phys. Lett., 19: 41-3(Sept. 15, 1965).

A determination of the average compound elastic cross section in the reaction ^{56}Fe(p,p$_0$)^{56}Fe at proton energies around 9.5 and 11.7 Mev by a fluctuation analysis of the experimental cross section for proton elastic scattering is summarized. (D.C.W.)

10035 ADMIXTURE OF STATES IN THE GROUND STATE OF ^{3}He. Ananthanarayanan, K. (MATSCIENCE, Madras). Phys. Lett., 19: 43-5(Sept. 15, 1965).

The differential cross section for meson(π^+) elastic scattering by ^{3}He was calculated using various admixtures of the T = $\frac{3}{2}$ and S′ states with the S-state. It was found that the differential cross section at 90° is considerably decreased by a small admixture of the T = $\frac{3}{2}$ state. Expressions were also obtained for the differential cross sections for meson(π^+) elastic scattering by ^{3}He and meson(π^-) elastic scattering by ^{3}H taking into account both the S′ and T = $\frac{3}{2}$ state admixtures. (D.C.W.)

10036 DECAY OF ISOBARIC ANALOGUE STATES IN ^{139}La TO THE EXCITED STATES OF ^{138}Ba. Zaidi, S. A. A.; Von Brentano, P.; Rieck, D.; Wurm, J. P. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Phys. Lett., 19: 45-7(Sept. 15, 1965).

Proton inelastic scattering by ^{138}Ba was studied in the energy range from 9.6 to 11.8 Mev. Strong resonances were observed in the differential cross section for scattering to the 1.426-Mev level. It was concluded that the resonances are due to the isobaric analogs of low-lying states in ^{139}Ba. The first two resonances were analyzed using the single resonance formula. (D.C.W.)

10037 A NEW ISOTOPE, ^{174}W. Demeter, I.; Sil, Kim Hon; Nadjakov, E.; Zaitseva, N. G. (Joint Inst. of Nuclear Research, Dubna, USSR). Phys. Lett., 19: 47-9(Sept. 15, 1965).

The isotope ^{174}W was obtained by irradiating a natural erbium target with 81-Mev ^{12}C ions using a maximum ion current of about 5 μamp for about one hour. The half life of ^{174}W was determined to be 31 ± 2 min by timed chemical separations using its genetic relation with the daughter isotope ^{174}Ta. (G.O.Y.)

10038 INTERMEDIATE STRUCTURE IN ELASTIC PROTON SCATTERING FROM ^{58}Ni. Swenson, L. W.; Izumo, K. (Franklin Inst., Swarthmore, Pa.). Phys. Lett., 19: 49-52(Sept. 15, 1965).

The elastic scattering of protons by ^{58}Ni in the energy range from 9.10 to 9.55 Mev was investigated. The data were fitted to a calculated form of the cross section containing both shape elastic and resonance amplitudes. It was concluded that at least for the case of proton elastic scattering by ^{58}Ni in the vicinity of 9 Mev, an intermediate resonance description is appropriate. (D.C.W.)

10039 SCATTERING OF 9.8 Mev PROTONS FROM TIN ISOTOPES AND THE SYMMETRY TERM IN THE OPTICAL MODEL POTENTIAL. Sood, P. C. (Univ. of Toronto). Phys. Lett., 19: 52-3(Sept. 15, 1965).

An optical model analysis of proton elastic scattering by tin isotopes is outlined which supports the existence of a symmetry term of the form $\pm V_1 (N-Z)/A$ in the nuclear potentials. (D.C.W.)

10040 A STUDY OF THE LOW LYING LEVELS OF ^{53}Cr BY INELASTIC SCATTERING, (d,t) AND (^{3}He,α) REACTIONS. Bock, R.; Duhm, H. H.; Jahr, R.; Santo, R.; Stock, R. (Max Planck Institut fuer Kernphysik, Heidelberg). Phys. Lett., 19: 417-19(Nov. 15, 1965).

Additional evidence is reported concerning the existence of collective components in addition to the single-particle ones in the wave functions of the ^{53}Cr excited states. It is shown also that the ^{52}Cr(d,p) cross section to the 1.28-Mev level is too large to be explained by the $f^{-2}_{\frac{7}{2}} p^{2}_{\frac{3}{2}}$ admixture to the ground-state wave-function of ^{52}Cr. The reactions (d,d′) on ^{52}Cr and ^{53}Cr, (^{3}He,α) on ^{52}Cr and ^{54}Cr and (d,t) on ^{54}Cr were investigated. The experimental results are given. The excitation of the low lying levels of ^{53}Cr by inelastic scattering and the spectra of different reactions leading to the final nucleus ^{53}Cr are shown. The various levels found are discussed. (J.F.P.)

10041 PREDICTION OF ABSOLUTE CROSS SECTIONS FOR THE REACTION $^{26}Mg(t,d)^{27}Mg$ BY CONSIDERATION OF THE TRITON INTERNAL WAVE FUNCTION. Glover, R. N. (Atomic Weapons Research Establishment, Aldermaston, Eng.); Jones, A. D. W.; Rook, J. R. Phys. Lett., 19: 493-5(Dec. 1, 1965).

Experimental measurements of the constant A, which theoretically includes the overlap for the dissociation of the triton or ^3He particle into d + n or d + p respectively, and which is introduced in DWBA treatment, are reported. Also an examination of the theory is made to try to account for the cross section discrepancy of which A is the measure. Angular distributions for the reactions $^{26}Mg(d,p)^{27}Mg$ and $^{26}Mg(t,d)^{27}Mg$ were measured at 10-Mev incident particle energy using a multichannel magnetic spectrograph. Optical model parameters for protons, deuterons, and tritons are given, and were used in the distorted wave analysis of the (t,d) and (d,p) reactions on Mg. The values of the constant A obtained for levels up to 4.15 Mev excitation in ^{27}Mg are also shown. The overall average value of A is found to be 1.8. (J.F.P.)

10042 NEW STUDY OF THE REACTIONS (p,2p) ON ^6Li AND ^7Li AT 155 Mev. Roynette, J. C.; Ruhla, Ch.; Arditi, M.; Jacmart, J. C.; Riou, M. (Laboratoire Joliot-Curie de Physique Nucleaire, Orsay, France). Phys. Lett., 19: 497-9(Dec. 1, 1965). (In French).

The reaction $^6Li(p,2p)$ was studied using the synchrocyclotron. Proton energies of 155 Mev were used. Spectra for the excitation energy of helium-5 deduced from the proton spectra from the reaction are shown. The angular distribution of protons from this reaction is also given. Also preliminary results from the reaction $^7Li(p,2p)$ were obtained. At least two states of helium-6 were observed. (J.F.P.)

10043 CHARGE ASYMMETRY AND THE THREE-NUCLEON SYSTEM. Stevens, M. St. J. (Univ. of Sussex, Brighton, Eng.). Phys. Lett., 19: 499-501(Dec. 1, 1965).

Two corrections to the two-nucleon potential due to the exchange of spin-zero systems, which yield contributions to Δ of the right order of magnitude are calculated. These are radiative corrections and corrections due to $\eta - \pi^0$ mixing. Second order electromagnetic radiative corrections to the meson (π)-nucleon vertex which do not diverge for high virtual photon momenta may be obtained using ps-pv coupling, and treating the nucleons as structureless Dirac particles. Since charged meson (π) exchange affects both nuclei equally, only meson (π^0) exchange must be considered. Also the nucleon hard core ensures that the major contribution comes from the exchange of mesons (π) whose momentum is small in the sense that its square is much less than the nucleon mass. (J.F.P.)

10044 STUDY OF THE FIRST 2^+ LEVEL IN THE EVEN Sm ISOTOPES. Campi-Benet, X.; Lombard, R. J. (Institut de Physique Nucleaire, Orsay, France). Phys. Lett., 19: 502-3(Dec. 1, 1965).

The properties of the first 2^+ level of even Sm isotopes were calculated in the framework of the quasi-particle model. Starting from the spherical shell model, the residual interaction was chosen as the conventional superposition of the pairing and the quadrupole forces. The extension of the configuration space leads to an improvement of the energy calculation and allows the computation of the transition probabilities without introducing any concept of effective charge. The neutron-proton pairing interaction is neglected since in the case of samarium, where protons and neutrons are filling different major shells, this approximation is not expected to influence the results significantly. The predictions of the model are compared with previous experimental data and given. It is concluded that the model yields acceptable results throughout the transition region, as far as the core configurations are included. But the results for deformed nuclei are considered open to criticism. (J.F.P.)

10045 ON THE ISOTOPE SHIFT ON THE EVEN ISOTOPES OF NATURAL SAMARIUM. Hansen, J. E.; Steudel, A.; Walther, H. (Technische Hochschule, Hanover). Phys. Lett., 19: 565-6(Dec. 15, 1965).

In order to check the proposal that the discrepancy in the relative isotopic shifts of the even stable isotopes of samarium (isotopes with a higher mass number are shifted to higher wave numbers) can be explained, if the mass dependent isotope shift is taken into account, more refined measurements of the samarium isotope shift were performed. Two lines with negative shift and three lines with positive shift were measured. Some of the results are shown, and an analysis of the data is discussed. The results of this analysis show that even with a higher experimental accuracy no peculiarities in the isotope shift of the even samarium isotopes can be found. The fact that there is a better fit if the change of the mass effect is considered, shows even more convincingly that the deviation in the relative isotopic shift found previously is due to the mass shift. (J.F.P.)

10046 ON THE PROPERTIES OF THE 27.78 kev LEVEL IN ^{129}I. Bemis, C. E.; Fransson, K. (Research Inst. for Physics, Stockholm). Phys. Lett., 19: 567-70 (Dec. 15, 1965).

The existence is reported of a class of unusually fast E2 transitions in the odd-A iodine isotopes for which recent experimental data are available including the results for ^{129}I. These transitions, described by the shell-model description as $g_{\frac{7}{2}} \rightleftharpoons d_{\frac{5}{2}}$, occur between the first excited states and the ground states in iodine-125 through iodine-131. The mixing ratio for the transition between the first excited state and the ground state in iodine-129 was determined from measurements of L subshell conversion line intensity ratios. The L-conversion electron spectrum for the 27.78-kev transition in iodine-129 from the decay of ^{129m}Te is shown, and the experimental reduced transition probabilities are given. It is concluded that while the quasiparticle-plus-phonon model may certainly be involved in explaining the M1 and E2 transitions in the odd-A iodine isotopes, other important factors must also be considered. (J.F.P.)

10047 EFFECT OF THE OPTICAL MODEL ON BARRIER PENETRATION. Vogt, E. (Chalk River Nuclear Labs., Can.); Michaud, G.; Reeves, H. Phys. Lett., 19: 570-3(Dec. 15, 1965).

It is shown that even for the extreme barrier penetration of interest in many astrophysical reactions the effect of the diffuse nuclear edge on reaction rates is as simple as for s-wave neutrons. For each diffuse edge potential one can specify an equivalent square well, with a depth similar to that of the diffuse-edge well but with a radius which may differ by ΔR from the mid-point radius of the diffuse edge well, in terms of which all the properties of the diffuse-edge well can be accounted for by multiplication of the usual square-well penetrabilities by a reflection factor, f. The result is that ΔR and f are independent of energy, of the presence of charge or angular momentum barriers, and of the magnitude of the imaginary part of the optical potential. To illustrate the usefulness of the connection between diffuse-edge wells and square wells, the ratio of the diffuse-edge optical model transmission functions to square-well transmission functions is shown as a function of the energy for the $^{32}S + \alpha$ problem. (J.F.P.)

10048 THE EXISTENCE OF THREE DOUBLETS IN ^{56}Fe. Shapiro, M. H. (Univ. of Pennsylvania, Philadelphia); Hinrichsen, P. F.; Middleton, R.; Mohindra, R. K. Phys. Lett., 19: 573-6(Dec. 15, 1965).

In order to observe doublets directly, the $^{56}Fe(p,p')^{56}Fe$ measurements were repeated using a magnetic spectrograph under conditions of optimum energy resolution. Exposures were made with an enriched iron-56 target at an incident energy of 8.0 Mev. All levels below 4 Mev in ^{56}Fe, except those at 3.386 and 3.747 Mev were observed. The energy values derived from these measurements are listed, and the line shapes of the 3.60-, 3.44-, and 3.12-Mev doublets at 50° are shown, with the line shape of the group from the 3.37 Mev level shown for comparison. The doublets are not resolved except in the case of the 3.60-Mev group, but the 3.12- and 3.44-Mev groups are definitely broader than those from adjacent single levels. (J.F.P.)

10049 NEGATIVE PARITY AND ISOBARIC ANALOGUE STATES IN ^{31}P. Davies, W. G.; Dawson, W. K.; Neilson, G. C. (Univ. Alberta, Can.). Phys. Lett., 19: 576-8 (Dec. 15, 1965).

The angular distributions of the neutron groups from the reaction $^{30}Si(d,n)^{31}P$ were studied using a high resolution time of flight spectrometer. Spins and parities were assigned to the five levels of ^{31}P and are shown. Spectra were obtained by bombarding an enriched ^{30}Si target with deuterons of 4 and 5 Mev. The angular distributions of the neutrons leading to the 5.012-, 6.46-, and 6.61-Mev states of ^{31}P for a deuteron energy of 5 Mev, and angular distributions of the neutrons leading to the 6.38- and 7.15-Mev states of ^{31}P are shown. Also the negative parity and isobaric analog states in ^{31}P are listed. These results are discussed. (J.F.P.)

10050 MAGNETIC MOMENT OF THE 405 kev $(7/2^-)$ LEVEL IN ^{211}Bi. Agarwal, Y. K.; Baba, C. V. K.; Bhattacherjee, S. K.; Ephraim, D. C. (Tata Inst. of Fundamental Research, Bombay). Phys. Lett., 19: 578-80(Dec. 15, 1965).

A measurement of the magnetic moment of the 405-kev $(7/2)$ state in bismuth-211 is described. A partial decay scheme of ^{211}Pb is shown from previous work. The measurements were made on the 702- to 405-kev cascade in ^{211}Bi for which the directional correlation coefficients were previously measured. The data were analyzed only for A_2 since the value of A_4 was found to be negligible. These results are given. It is concluded that the measured magnetic moment of the 405-kev $(7/2^-)$ state in ^{211}Bi indicates possible core polarization irrespective of whether the state is a pure $f_{9/2}$ state or a state formed by coupling of the $h_{9/2}$ proton to the $(g^2_{9/2})_{2+}$ state of the two neutrons. (J.F.P.)

10051 THE IMPORTANCE OF THE STRONG ISOTOPIC SPIN DEPENDENCE OF PARTICLE-HOLE MATRIX ELEMENTS ON THE MANY PARTICLE-MANY HOLE STATES IN NUCLEI. Zamick, L. (Princeton Univ., N. J.). Phys. Lett., 19: 580-3(Dec. 15, 1965).

Some of the properties of the excited states in nuclei whose configurations consist of holes in the 1p shell and particles in the 2s-1d shell are determined. The $f_{7/2}$ shell is also considered briefly. The results for carbon-14, nitrogen-15, oxygen-16, -17, and -18, and neon-20 are given. It is concluded that the techniques of French and Bansal (Physics Letters 11: 145(1964)) are very fruitful in determining properties of particle-hole excitations, and that it is essential to take into account the strong isotopic spin dependence of the particle-hole interaction to obtain meaningful results. (J.F.P.)

10052 REALISTIC FORCES IN THE NUCLEAR SHELL-MODEL. Kim, Y. E. (Oak Ridge National Lab., Tenn.). Phys. Lett., 19: 583-6(Dec. 15, 1965).

Nigam (Phys. Rev., 133: B1318(1964)) proposed a practical method for solving the Schroedinger equation in the relative coordinate for calculating the t matrix as the interaction to be diagonalized in a shell-model calculation. This method involves a hard core potential and a harmonic oscillator potential. The practicality of Nigam's method is investigated for the cases of both the Brueckner-Gammel-Thaler potential and the more recent Hamada-Johnston potential. (J.F.P.)

10053 DEUTERON SCATTERING ON HEAVY NUCLEI. Bencze, Gy.; Pietarinen, E. (Univ., Helsinki). Phys. Lett., 19: 586-8(Dec. 15, 1965).

The results of some preliminary calculations of the elastic scattering of deuterons on heavy nuclei are reported. In the case of heavy nuclei and for energies less than the Coulomb barrier the nuclear interactions are expected to be negligible and the effect of the breakup processes can be treated separately. The effect of both the real and virtual breakup process can be taken into account by a phenomenological complex long-range potential. The elastic scattering of 11-Mev deuterons on tantalum-181, gold-197, bismuth-209, and uranium-238 is shown and compared with experimental values. The best fit parameter and the total cross section of electrodisintegration in mbarns is shown for each of these nuclei. The calculations show that the elastic scattering of deuterons on heavy nuclei can be derived by means of a simple phenomenological long range potential. The adiabatic polarizability potential cannot explain the experimental data. (J.F.P.)

10054 BCS MODEL CALCULATIONS OF MEAN PRIMARY CHARGE DISTRIBUTION IN LOW ENERGY FISSION ON ^{236}U. Noerenberg, W. (Technische Hochschule, Muenchen). Phys. Lett., 19: 589-90(Dec. 15, 1965).

For this calculation the potentials are assumed to have quadrupole and octopole deformations with coaxial symmetry. The single particle vectors are expanded in terms of eigenvectors of the unperturbed spherical fragments. To calculate matrix elements an extended Nilsson model is used relating the nuclear proton potential to the neutron potential and taking account of the Coulomb potential and octopole deformation. The Wahl diagram of mean primary charges in thermal neutron fission of ^{235}U is shown with both theoretical and experimental values. The charge distribution is practically independent of fragment deformations and densities, and it seems to result mainly from the Coulomb interaction between the fragments, the asymmetry energy, and the level density of the fragments. (J.F.P.)

10055 TRIPLE CORRELATIONS IN MULTIPLE GAMMA CASCADES IN ^{36}Ar. Erne, F. C. (Rijksuniversiteit, Utrecht). Phys. Lett., 19: 590-2(Dec. 15, 1965).

The main results from $(p,\gamma\gamma)$ triple correlation and polarization measurements at eight resonances are reported. Proton energies of 3 Mev were used in the $^{35}Cl(p,\gamma)^{36}Ar$ reaction. The energies, strengths, spins, parities, and isospins, and l_p values of the investigated resonances in the reaction studied are given. Also the decay scheme for argon-36 is shown with spins, parities, and multipolarity mixing parameters taken from the investigation. (J.F.P.)

10056 FORM-FACTOR CALCULATIONS IN DIRECT REACTIONS. Huby, R.; Hutton, J. L. (Univ. of Liverpool). Phys. Lett., 19: 660-2(Jan. 1, 1966).

A calculation going beyond single-particle form factors is made to explain the observed j-dependence of the forward peak in some (p,d) angular distributions. (auth)

10057 SINGLE-HOLE ENERGIES AND FOUR PARTICLE BETHE-FADDEEV EQUATIONS. Easlea, B. R. (Univ. Rio Grande do Sul, Porto Alegre, Brazil). Phys. Lett., 19: 662-5(Jan. 1, 1966).

It is pointed out that the well known result that hole energies can be put on the energy shell is a direct consequence of summing the (nonconvergent) series of a class of four-particle correlation diagrams to infinite order, and the exact result is proved using the Bethe-Faddeev equations. It is also shown that the series can be summed in the approximate way used by Bethe for the three-particle correlation diagrams, and a rough comparison between the approximate solution and the exact result is presented. (L.B.S.)

10058 A NOTE ON THE LINEAR BOGOLIUBOV TRANSFORMATION FOR PROTON-NEUTRON CORRELATIONS. Kissener, H.-R.; Muenchow, L. (Central Inst. for Nuclear Research, Rossendorf, Ger.). Phys. Lett., 19: 665-7(Jan. 1, 1966).

The charge-independent pairing force is treated in the jj-scheme by means of the linear Bogoliubov–Valatin transformation containing three real parameters. It is argued that the small four-particle correlations produced by the pairing force are suppressed in a Bogoliubov–Valatin transformation treatment without projection. When the fluctuation terms are eliminated, the energy exhibits again the quadrupling effect. (L.B.S.)

10059 PROBABILITIES OF β DECAY OF NUCLEI IN THE TRANSITION REGION. Berlovich, E. E.; Novikov, Yu. N. (Ioffe Inst. of Physics and Tech., Leningrad). Phys. Lett., 19: 668-9(Jan. 1, 1966).

It is shown that beta transitions between odd-proton and

neighboring odd-neutron spherical nuclei are systematically characterized by large log ft values due to the change of nuclear form. (L.B.S.)

10060 GAMMA-RAY SPECTRA FROM THE RADIATIVE CAPTURE OF 7.4-Mev NEUTRONS. Bergqvist, I. (Research Inst. of National Defence, Stockholm); Lundberg, B.; Nilsson, L.; Starfelt, N. Phys. Lett., 19: 670-2 (Jan. 1, 1966).

Gamma-ray spectra from the capture of 7.4 Mev neutrons in iron, nickel, lead, and bismuth were measured. using a large NaI crystal. The results show good agreement with the collective capture-theory of Brown (Nucl. Phys., 11: 339(1964)) and Clement et al. (Nucl. Phys., 66: 273, 293(1965)). (L.B.S.)

10061 OBSERVATION OF THE MOESSBAUER EFFECT FOLLOWING COULOMB EXCITATION OF ^{73}Ge. Czjzek, C.; Ford, J. L. C. Jr.; Obenshain, F. E.; Seyboth, D. (Oak Ridge National Lab., Tenn.). Phys. Lett., 19: 673-5 (Jan. 1, 1966). (ORNL-P-1790).

Measurement of the Moessbauer spectra of ^{73}Ge with the 67.0 kev level populated by Coulomb excitation is reported, and the results are analyzed. (L.B.S.)

10062 INFLUENCE OF THE (p,n) CHANNELS ON THE ^{40}A(p,p$_i\gamma$) ANGULAR CORRELATION. Hulubei, H.; Berinde, A.; Martalogu, N.; Neamu, I.; Scintei, N. (Inst. for Atomic Physics, Bucharest). Phys. Lett., 19: 675-6(Jan. 1, 1966).

An account is given of the results of measurements of the angular correlation between the protons exciting the first 2^+ level of ^{40}Ar and the de-excitation gamma rays to the ground state, for 4 Mev incident protons. It is shown that the shape of the angular correlation curve is well described by the statistical model, but that the (p,n) channel of the compound nucleus disintegration should be taken into account. (L.B.S.)

10063 CLUSTER STRUCTURE AND THE COULOMB ENERGY DIFFERENCE OF MIRROR NUCLEI. Okamoto, K. (Univ. of New South Wales, Kensington, Australia). Phys. Lett., 19: 676-9(Jan. 1, 1966).

It is shown that the cluster structure for light mirror nuclei >3 decreases the Coulomb energy E_c, and that the Coulomb energy difference is generally smaller than the binding energy difference by a sizable fraction (20–30%), which indicates charge asymmetry of nuclear forces. It is also shown that (p,2p) or (e,e'p) reactions are much more suitable for determining the wave function of the last proton. (L.B.S.)

10064 MIXED PERTURBATIONS OF DIRECTIONAL CORRELATIONS IN ^{181}Ta. Cannon, T. W.; Schecter, L. (Oregon State Univ., Corvallis). Phys. Lett., 19: 680-1 (Jan. 1, 1966).

Differential anisotropies were measured for the 133–482 kev gamma cascades of ^{181}Ta nuclei embedded in hafnium metal in order to obtain information about magnetic moments or asymmetry parameters, for the case of mixed magnetic dipole and electric quadrupole interaction. Poor agreement was found with theoretical calculations, and it is concluded that practical application of the theory is difficult using a solid source and electric and magnetic interaction strengths which are roughly comparable, in those cases where it is important to take account of the variation of electric environment from one nuclear site to another. (L.B.S.)

10065 TOTAL AND K CONVERSION COEFFICIENT MEASUREMENTS IN ^{54}Cr, ^{65}Cu AND ^{88}Sr FOR USE AS STANDARDS. Hamilton, J. H. (Vanderbilt Univ., Nashville); Amtey, S. R.; Van Nooijen, B.; Ramayya, A. V.; Pinajian, J. J. Phys. Lett., 19: 682-3(Jan. 1, 1966). (ORNL-P-1833).

Total and K-conversion coefficients were measured for the 835.0, 898.2, and 1115.6 kev transitions in ^{54}Cr, ^{88}Sr, and ^{65}Cu, respectively ($\alpha_K \times 10^6 = 224 \pm 10$, 301 ± 21, 166.4 ± 6.6, respectively). These isotopes provide useful α_K calibration standards for decay scheme studies. (auth)

10066 TRANSMISSION OF 8 AND 15 Mev NEUTRONS THROUGH ORIENTED ^{165}Ho. Shelley, E. G.; Fisher, T. R.; Safrata, R. S.; McCarthy, J.; Austin, S. M. (Stanford Univ., Calif.). Phys. Lett., 19: 684-6(Jan. 1, 1966).

The effect of nuclear orientation on the neutron total cross section of ^{165}Ho was measured at neutron energies at 8 and 15 Mev. The result is in reasonable agreement with the theoretical prediction of a coupled channel calculation. (auth)

10067 DESTRUCTIVE INTERFERENCE OF HOLE AND COLLECTIVE E2 TRANSITION AMPLITUDES. Rose, H. J. (Oxford Univ.); Lopes, J. S.; Greiner, W. Phys. Lett., 19: 686-9(Jan. 1, 1966).

An effect of destructive interference between the single-hole and collective contribution to the E2-matrix element, which was previously suggested in order to explain the E2/M1 mixtures of the 6 Mev, $\frac{3}{2}^- \rightarrow \frac{1}{2}^-$ transition in ^{15}N and ^{15}O, is investigated. It is shown from calculation of the total E2 amplitude that destructive interference will occur if the unperturbed single-hole state is located in energy above the unperturbed collective state of the core. The effect is independent of whether the deformed contribution is oblate or prolate and of whether the deformed contribution to the ^{16}O ground state adds with positive or negative phase. (L.B.S.)

10068 A NEW METHOD FOR DEUTERON ELASTIC SCATTERING CALCULATIONS. May, R. M. (Univ. of Sydney). Phys. Lett., 19: 689-91(Jan. 1, 1966).

An expression is presented for the deuteron elastic scattering cross section in terms of the individual neutron and proton scattering amplitudes. The high energy limit and a low energy approximation, which is compared with experiment, are also given. (auth)

10069 RATIO OF C_A AND C_V IN NUCLEAR β DECAY. Bhalla, C. P. (Univ. of Alabama, Huntsville). Phys. Lett., 19: 691-2(Jan. 1, 1966).

It is reported that more refined calculations of the ft values of the neutron and ^{14}O lead the ratio $|C_A/C_V| = 1.18 \pm 0.02$. (L.B.S.)

10070 LEVEL STRUCTURE OF ^{39}Ar BY THE ^{40}Ar (d,t)^{39}Ar REACTIONS. Rosner, B.; Schneid, E. J. (Univ. of Pittsburgh). Phys. Lett., 19: 692-4(Jan. 1, 1966).

Angular distributions were obtained for the first four excited states of ^{39}Ar. Using DWBA calculations, values of angular momentum transfer of $l_n = 3, 1, 2$, and 0 respectively were obtained which are in agreement with the data from the (p,d) reaction. (auth)

10071 ^{47}K MASS FROM THE REACTION ^{48}Ca(d,^{3}He)^{47}K. Newman, E. (Oak Ridge National Lab., Tenn.); Hiebert, J. C.; Zeidman, B. Phys. Rev. Lett., 16: 28-30(Jan. 3, 1966). (ORNL-P-1818).

The Q-value for the reaction ^{48}Ca(d,^{3}He)^{47}K was measured and was used to determine the mass of ^{47}K. The first excited state of ^{47}K was established at 370 ± 15 kev, and the ground state and the first excited state of ^{47}K were identified as $(1d_{\frac{3}{2}})^{-1}$ and $(2s_{\frac{1}{2}})^{-1}$ proton states, respectively. (D.C.W.)

10072 PROPOSAL FOR AN EXPERIMENT ON ADIABATICALLY INDUCED COULOMB FISSION. Guth, Eugene (Oak Ridge National Lab., Tenn.); Wilets, Lawrence. Phys. Rev. Lett., 16: 30-2(Jan. 3, 1966).

An experiment for studying the saddle-point configuration is proposed in which a Coulomb field is used to distort the "cold" nucleus up to a saddle point, after which the nucleus slides down the potential hill to scission. (D.C.W.)

10073 ABSORPTION OF SOLAR NEUTRINOS IN DEUTERIUM. Kelly, Francis J. (Catholic Univ. of America, Washington, D. C. Naval Ordnance Lab., Silver Spring, Md.); Ueberall, H. Phys. Rev. Lett., 16: 145-7(Jan. 24, 1966).

The cross section and the electron spectrum for the reaction $\nu_e + {}^2\mathrm{H} \rightarrow 2{}^1\mathrm{H} + e^-$ were calculated. The results indicate that the reaction can be used to detect solar neutrinos by observation of the Cherenkov radiation of the electrons in a heavy-water target. (D.C.W.)

10074 DETERMINATION OF SEPARABLE POTENTIAL FROM PHASE SHIFT. Bolsterli, M. (Univ. of Minnesota, Minneapolis. Univ. of California, Los Alamos,

N. M.); MacKenzie, J. Physics, 2: 141-9(Nov. 1965). (LA-DC-7345).

An explicit formula is given for the separable potential that fits a given phase shift. In addition, similar formulas are given for cases where there is a bound state, where sin δ changes sign, and where the phase shifts arise from coupled equations. (auth)

10075 FLUORESCENCE YIELD OF THE L LEVEL OF Ra. Gil, F. Braganca (Recherches Scientifiques d'Outre-Mer (J.I.U.), Lisbon); Miranda, C. F.; Lobo, J. Sousa; Ferreira, J. Gomes. Port. Phys., 4: 17-32(1965). (In Portuguese).

A study was made of the α-X_L coincidences emitted on the decay $^{228}Th \xrightarrow{\alpha} {}^{224}Ra$, and the fluorescence yield of radium was determined. The experimental result is $\omega_L = 0.40 \pm 0.03$. (auth)

10076 REACTIONS (p,xn) AND NUCLEAR EVAPORATION. da Silveira, Rui (Univ. Paris, Orsay, France). Port. Phys., 4: 33-110(1965). (In Portuguese).

The formalism of the statistical model is applied to the study of the de-excitation of the nodules formed by the bombardment of Bi, Au, and Tb with energies ranging from 50 to 155 Mev. Based on Serber's interaction model the outputs of isotopes formed by reactions (p,xn) — Bi, Tb — and the spectrum of evaporation of alpha particles — Bi, Au — are evaluated. Besides Jackson's approach, the emission of charged particles by using the Monte Carlo method is observed. The figures obtained are compared with experimental data, and some changes are suggested concerning the evaporation evaluation. (auth)

10077 THE HYPERFINE STRUCTURE OF ^{167}Er AND MAGNETIC MOMENTS OF $^{143,145}Nd$ AND ^{167}Er BY ATOMIC BEAM TRIPLE MAGNETIC RESONANCE. Smith, K. F.; Unsworth, P. J. (Cavendish Lab., Cambridge, Eng.). Proc. Phys. Soc. (London), 86: 1249-57(Dec. 1965).

The hyperfine structure constants of the $4f^{12}6s^2\ {}^3H_6$ ground state of ^{167}Er were found by atomic beam magnetic resonance to be A = −120.4864(5) and B = −4552.959(23) Mc/s. Direct measurement by triple magnetic resonance of the nuclear magnetic dipole moments of ^{167}Er, ^{143}Nd and ^{145}Nd gives values of −0.5647(24) n.m., −1.063(5) n.m., and −0.654(4) n.m. respectively. Values for $\langle r^{-3}\rangle_{4f}$ are deduced in each case and the corresponding nuclear electric quadrupole moments are 2.827(12) bn, −0.484(20) bn and −0.253(10) bn. (auth)

10078 A STUDY OF THE REACTION $^{10}B(^3He,d)^{11}C$ BETWEEN 3.5 AND 10 Mev. Patterson, J. R.; Poate, J. M.; Titterton, E. W.; Robson, B. A. (Australian National Univ., Canberra, Australia). Proc. Phys. Soc. (London), 86: 1297-1304(Dec. 1965).

The $^{10}B(^3He,d)^{11}C$ reaction was investigated over the energy range 3.5 to 10 Mev. Excitation functions for the ground state transitions were obtained at laboratory angles of 45, 90, and 150° and detailed angular distributions were measured at bombarding energies of 3.7, 5.8, 7.5 and 9.8 Mev. The 150° excitation function shows a resonance at approximately 5.8 Mev, corresponding to an excitation of 26 Mev in the ^{13}N system. This resonance, also observed in an earlier study of the $^{10}B(^3He,\alpha)^9B$ reaction, may be identified with giant resonance structure in ^{13}N. A measurement of the total deuteron cross section by an activation method shows no evidence for the resonance. The $(^3He,d_0)$ angular distributions indicate the reaction to be predominantly a direct process and they have been fitted successfully using a distorted wave Born approximation analysis. Only a stripping mechanism is necessary to explain the forward and backward peaking. (auth)

10079 COLLECTIVE VIBRATIONS IN NUCLEI. Green, A. M. (Inst. of Theoretical Physics, Copenhagen). Rep. Progr. Phys., 28: 113-67(1965).

A survey is given of recent developments in the theory of collective vibrations in nuclei based on the shell model. This covers work up to and including the International Conference on Nuclear Physics in Paris during 1964. The emphasis is on the application of the theory, which is illustrated by considering specific nuclei, for example ^{16}O, ^{40}Ca, and ^{208}Pb, for the simplest case of nuclei having both the neutron and proton shells closed. The nickel, tin, and lead regions are studied to show the effect of pairing, when the shells are no longer closed but the nuclei are still assumed to be spherical. The additional complications with deformed nuclei are illustrated in the rare earth and transuranic regions, and also with magnesium. (auth)

10080 ON THE ABSORPTION OF STOPPED π^- MESONS BY ^{12}C NUCLEI. Cheon, Il-Tong; Sakamoto, Yoshiyuki; Nguyen-Trung, Chi. (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 34: 574-83(Oct. 1965).

Absorption of a stopped π^- meson by a nucleon pair in light nuclei is considered with the emission of a high energy nucleon while the other nucleon is trapped by the nucleus and renders the latter strongly excited. Calculation is performed for ^{12}C nuclei, and the excitation energy distribution of the residual nucleus ^{11}B is compared with experimental results. (auth)

10081 SURVEY OF SOME SYSTEMATIC PROPERTIES OF THE NUCLEAR E1 TRANSITION PROBABILITY. Perdrisat, Charles F. (Univ. of Illinois, Urbana). Rev. Mod. Phys., 38: 41-94(Jan. 1966).

A survey of the experimental data for E1 transitions between levels below nucleon emission threshold in medium and heavy nuclei is presented. A general classification of these transitions is proposed, and it is shown that, within most of the classes defined, the experimental reduced E1 transition probabilities differ by less than a factor 10^4. The data are compared with specific nuclear model predictions. Precise theoretical descriptions of the anomalous parity states involved in E1 transitions exist in a few cases only. However it is often possible to link the observed behavior of E1 transition rates as a function of different parameters with qualitative model predictions. The data available before 1 January, 1965, are presented in tables including level lifetimes, quantum numbers, branching ratios, internal-conversion data, and deduced transition probabilities. (auth)

10082 QUASI-FREE SCATTERING AND NUCLEAR STRUCTURE. Jacob, Gerhard; Maris, Th. A. J. (Univ. do Rio Grande do Sul, Porto Alegre, Brazil). Rev. Mod. Phys., 38: 121-42(Jan. 1966).

Quasi-free processes in nuclei are reviewed both from a theoretical and an experimental point of view. The discussion is limited to nuclei with mass number ≥4 and to incident energies larger than 100 Mev for quasi-free proton-proton and 300 Mev for electron-proton scattering. The reactions are discussed qualitatively, and their relevance for the investigation of nuclear shells, in particular of the strongly bound ones, is shown. The cross section for quasi-free scattering is then derived in the distorted wave impulse approximation, and some special cases are considered. Through a few examples the main features of the experimental results are presented and compared with calculated ones. Measurements on several 1p, 2s−1d, and 2p−1f shell nuclei are discussed. (auth)

10083 COMPOUND INELASTIC NUCLEON AND GAMMA-RAY ANGULAR DISTRIBUTIONS FOR EVEN- AND ODD-MASS NUCLEI. Sheldon, Eric (Eidgenoessiche Techinische Hochschule, Zurich); Van Patter, Douglas M. Rev. Mod. Phys., 38: 143-86(Jan. 1966).

The current theoretical and experimental status of angular distributions of inelastically scattered nucleons and succeeding γ radiations on the basis of a compound-nucleus mechanism is reviewed, with special reference to symmetry, isotropy, and identity characteristics. Results of investigations using a fast computer to ascertain the influence of higher partial waves, multipole mixing, unobserved intermediate transitions, and the presence of additional exit channels are presented, together with an over-all survey of distribution systematics and tabulations of numerical parameters to assist in evaluation of differential cross sections by hand. The predictions for both proton and neutron inelastic scattering are discussed in detail and illustrated by analyses of experimental data for many nuclear spin sequences. In particular, it is shown for γ distributions that the effect of cascades from higher

levels upon the distribution structure and magnitude can be very appreciable. Also, the examination of the predicted behavior of $(n,n'\gamma)$ distributions near threshold disclosed features deserving of further experimental and theoretical study. A set of recently measured $(n,n'\gamma)$ distributions for several heavy nuclei involving transitions between nuclear states of relatively high integer or half-integer spin is shown to compare well with the theoretical predictions when suitable account is taken of cascade and exit-channel contributions. It is concluded that there is a wide range of application of this theoretical approach to energy-averaged distributions, much of which remains yet to be exploited. (auth)

10084 ON THE STUDY OF THE DECAY MODE OF ^{180i}Ta. Badescu-Singurianu, A. I.; Grecescu, M.; Ionescu, V. A.; Nascutiu, T. (Inst. of Atomic Physics, Bucharest). Wiss. Z. Friedrich-Schiller-Univ. Jena, Math.-Naturw. Reihe, 13: 517-21(1964). (In Russian).

Isomeric ^{180}Ta was produced by the (γ,n) reaction on ^{181}Ta. The total gamma spectrum of ^{180i}Ta is presented. Four new lines in the gamma spectrum were found at 212 ± 1.37, 329.8 ± 1.5, 440.3 ± 1.8, and 503.5 ± 1.9 kev, corresponding to a new ^{180}Ta isomer, which decays to ^{180i}Hf by K capture with a half life of 5.5 hr. (TCO)

10085 CIRCULAR POLARIZATION MEASUREMENTS ON ^{59}Fe. Kneissl, U.; Schneider, H. (Universitaet, Giessen, Ger.). Z. Naturforsch., 20a: 1088-9(Aug. 1965). (In German).

The circular polarization of the 1289- and 1097-kev γ quanta was measured from the Compton forward scattering on magnetized iron. The results are graphed showing the relative decay rate difference E as a function of v/c. The asymmetry parameters for the transitions were determined as $A_{1097} = 0.25 \pm 0.07$ and $A_{1289} = 0.02 \pm 0.15$. These results are in good agreement with previous studies. The mixing ratio δ of the 1097-kev radiation was determined as $-0.54 < \delta < -0.29$. The relative Fermi matrix element was determined as $-0.07 < X < +0.6$. (J.S.R.)

10086 YIELD OF THE REACTION Ag(γ,t) WITH BREMSSTRAHLUNG UP TO 55.7 Mev. Wiik, Bjoern (Technische Hochschule, Darmstadt, Ger.). Z. Phys., 189: 423-32(1966). (In German).

The yield of triton production from silver irradiated with bremsstrahlung ranging in maximum energy between 31.2 and 55.7 Mev was measured relative to the $C(\gamma,n)^{11}C$ reaction. The silver targets were dissolved in nitric acid, the water converted to hydrogen gas, and the tritium activity counted in a low-level Geiger counter. Above threshold, the quantity σ_γ (approximately equal to the bremsstrahlung-weighted cross section) increases roughly linearly with maximum energy and reaches (19 ± 1) μb at 55.7 Mev. A comparison with the statistical theory of nuclear evaporation shows that the experimental yields exceed the theoretical predictions by a factor of 100 to 1000. (auth)

10087 THE COMPOUND-STATISTICAL MECHANISM IN SIMPLE NUCLEAR REACTIONS [Thesis]. Hurwitz, Camilla. St. Louis, Washington Univ., 1965. 150p.

Recoil range measurements were made on the ^{103}Rh(α,n) ^{106m}Ag and ^{103}Rh(α,2n)^{105}Ag reactions from threshold to approximately 40 Mev. From the range of the recoiling products, the (α,n) reaction was found to proceed predominantly through a compound nucleus mechanism up to a few Mev beyond the energy corresponding to the maximum cross section, at which point contributions from non-compound processes become significant and increase in importance with increasing bombarding energy. On the other hand, the (α,2n) reaction was found to be completely compound nuclear over most of the energy range studied with some possible contribution from a non-compound process at the very high energies where the cross section decreases with increasing bombarding energy. For comparison, experimental data at 20-Mev bombarding energy from differential measurements on the ^{103}Rh(α,p)^{106}Pd and ^{103}Rh(α,α')^{103}Rh reactions were analyzed. Data already in the literature for energy spectra of protons and alpha particles from the bombardment of various elements at bombarding energies of 20, 30, and 40 Mev were included. In previous similar analyses of energy spectra, the level density parameter, a, for example, was found to decrease with increasing bombarding energy and it was suspected that this decrease is due to the neglect of the distributions in angular momentum of the compound and residual nuclei. The analysis undertaken here included the effects of both of these distributions. The present analysis showed that the decrease in the a-value is only partly due to the neglect of angular momentum distributions. Most of the decrease must therefore be due to the presence of an admixture of a direct reaction contribution which increases in importance with increasing projectile energy. (Dissertation Abstr.)

10088 STUDY OF NEUTRONS FROM THE LITHIUM BOMBARDMENT OF SEVERAL LIGHT NUCLEI [Thesis]. Lewis, Charles William. Minneapolis, Univ. of Minnesota, 1964. 85p.

A survey study of neutron-producing reactions induced by the lithium bombardment of selected light elements was made. Thick-target angular distributions were obtained for the following transitions: the ground states of the ^{9}Be(^{7}Li,n)^{15}N and ^{11}B(^{6}Li,n)^{16}O reactions, and the ground and first excited state of the ^{7}Li(^{6}Li,n)^{12}C reaction. The first two transitions were studied at a laboratory bombarding energy of 3.7 Mev and in the laboratory angular range of 0 to 140°. The corresponding conditions for the latter two transitions were 3.4 Mev and 0 to 120°. Absolute differential cross sections for the transitions were obtained from the thick-target yields in the usual manner. Neutron detection was accomplished by the organic scintillator method, in which the energy distribution of an incident flux of neutrons is inferred from the resulting pulse height distribution produced by recoil protons in the scintillator. The technique of pulse shape discrimination was employed to eliminate contamination of the proton pulse spectra due to gamma rays interacting with the scintillator. Choice of the organic scintillator method entailed development of a theory of the proton pulse spectrum appropriate to neutrons in the energy range 10–30 Mev. An expression for the pulse spectrum was derived which takes account of all factors which significantly influence the shape of an experimental spectrum. The experimental quantities of interest enter as parameters in the theoretical expression, and were obtained by a least squares fit (by computer) of the expression to each experimental pulse height spectrum. (Dissertation Abstr.)

10089 BETA–GAMMA DIRECTIONAL CORRELATION MEASUREMENTS IN SOME ANOMALOUS BETA TRANSITIONS [Thesis]. Petry, Robert Franklin. Bloomington, Ind., Indiana Univ., 1964. 131p.

Beta-gamma directional correlation studies were made for beta transitions in the radioactive nuclei ^{22}Na, ^{72}Ga, ^{186}Re and ^{188}Re. For ^{22}Na, the 0.544-Mev positron transition from the 3^+ ground state to the 2^+ first excited state of ^{22}Ne was studied. This is followed by a pure E2 gamma transition to the stable ground state of ^{22}Ne. The anisotropy was measured at seven positron energies and from this the correlation coefficient ϵ was found to vary from -0.003 ± 0.002 to -0.017 ± 0.004, where ϵ decreases with increasing energy. An analysis of this data was carried out using the theory developed by Morita, which includes second forbidden contributions to normally allowed decays, and the shape measurements of Hamilton, Langer and Smith. The results of this analysis confirm the conjecture, based on the abnormally large ft value, that the Gamow-Teller matrix element is suppressed by several orders of magnitude. Values for the ratios of the four contributing second order matrix elements to the Gamow-Teller matrix element are obtained. The transitions considered in ^{72}Ga, ^{186}Re, and ^{188}Re are all examples of first forbidden non-unique transitions, and each is followed by a pure E2 gamma ray. The spin sequence for ^{72}Ga is $3^- - 2^+ - 0^+$ while for ^{186}Re and ^{188}Re it is $1^- - 2^+ - 0^+$. The anisotropy for the 3.166-Mev outer group of ^{72}Ga was measured at six beta energies which range from 2.4 to 2.9 Mev. The correlation coefficient derived from this

varies from -0.25 ± 0.01 to -0.31 ± 0.01, decreasing with increasing energy. For ^{186}Re, the anisotropy for the first inner group was measured at ten beta energies selected in the range from 150 to 850 kev. Here ϵ varied from 0.003 ± 0.004 to 0.082 ± 0.006, this time increasing with increasing energy. A similar increase of ϵ with increasing energy was found for the case of ^{188}Re where ϵ varied between 0.092 ± 0.007 and 0.181 ± 0.012 for the energy range 1.0 to 1.65 Mev. Again the first inner group was considered. For these three examples, a method of analysis previously used by Sastry was employed. This method yields values of the nuclear matrix elements involved in the transitions when the shape, directional correlation, and beta-circularly polarized gamma correlation are known. The suggestion of Kotani that the "B_{ij}" matrix element dominates these transitions is confirmed. (Dissertation Abstr.)

10090 PARTICLE SPECTRA, RECOIL RANGES, AND EXCITATION FUNCTIONS OF ^{3}He INDUCED REACTIONS ON ^{56}Fe [Thesis]. Hazan, Jean-Pierre. Rochester, N. Y., Univ. of Rochester, 1965. 186p.

The angular distributions and shape of the spectra of the emitted protons in the ^{56}Fe(^{3}He,p) reaction, and recoil ranges of residual nuclei and excitation functions for the ^{56}Fe(^{3}He,p)^{58}Co, ^{56}Fe(^{3}He,pn)^{57}Co, ^{56}Fe(^{3}He,2n)^{57}Ni, ^{56}Fe(^{3}He, p2n)^{56}Co, and ^{56}Fe(^{3}He,3n)^{56}Ni reactions were studied. The particle emission study was performed with 10.25-Mev incident ^{3}He energy, while the latter study was done with incident ^{3}He energies from 5.7 to 29.3 Mev. Proton spectra were measured at nine different angles from 150 to 30° lab. The angular distributions were isotropic at all angles observed up to ≈8 Mev E_{cms} and beyond 60°, up to an energy of ≈9.5 Mev E_{cms}. Comparison of the normalized calculated curve and the experimental results seem to show a very high contribution from compound nucleus mechanisms. Calculated absolute cross sections seem to yield too low results in comparison with the measured values. This discrepancy was largely removed by taking into account nuclear shell effects according to the Rosenzweig model. Recoil range measurements indicate that compound nucleus mechanism is dominant up to energies equal to that of the peak of the excitation functions measured, and usually several Mev beyond. Statistical model calculations were performed and compared with the experimental excitation functions. A shift in peak position between the calculated and experimental curve could essentially be accounted for by assuming that part of the incident ^{3}He energy was tied up in rotational energy of the compound nucleus. Nuclear shell effects for residual nuclei at or near the "doubly magic" ^{56}Ni were prominent and could be explained in terms of a simple model. It is concluded that the compound nucleus mechanism is dominant in the ^{3}He reactions studied, and that the statistical model provides a quite good description of the features of those reactions. (Dissertation Abstr.)

10091 TRANSVERSE POLARIZATION OF K-CONVERSION ELECTRONS FOLLOWING THE BETA DECAY OF ^{198}Au [Thesis]. Rasera, Robert Louis. Lafayette, Ind., Purdue Univ., 1965. 140p.

The degree of transverse in-the-plane polarization of the K-conversion electrons following the main branch beta decay of ^{198}Au was measured, using a lens spectrometer as the conversion-electron energy selector. The beta decay of ^{198}Au is of the first-forbidden non-unique type, and satisfies the Coulomb approximation very well. The results can therefore be expressed in terms of a quantity K_k, related to the degree of transverse polarization P_{ti} (θ) by the relation $P_{ti} = K_k (v/c) \sin \theta$ where v/c refers to the preceding beta particle and θ is the angle between the beta and conversion electron momenta. The experiment was performed by observing the conversion electrons at right angles to, and in coincidence with, the preceding beta particles. The conversion electrons were focused by a lens spectrometer on a gold foil of thickness 0.71 mg/cm^2. The polarization of the beam was analyzed by Mott scattering through a nominal instrument angle of 120°. The result of the measurement was a measured scattering asymmetry $\delta = (N_L - N_R)/(N_L + N_R) = -0.044 \pm 0.013$ which, when corrected for finite geometry, spin rotation and plural scattering yields a value $K_k = +0.43 \pm 0.17$. The error includes statistical error and error in the corrections. A positive sign for K_k means that the conversion electron is polarized parallel to the direction of the preceding beta particle. This result is consistent with that expected from the beta-circularly polarized gamma correlation. (Dissertation Abstr.)

10092 A STUDY OF FIRST AND SECOND EXCITED STATES IN SOME EVEN-EVEN NUCLEI BY BETA–GAMMA ANGULAR CORRELATIONS [Thesis]. Raghavan, Ramaswamy Srinivasa. Lafayette, Ind., Purdue Univ., 218p.

Beta-gamma directional correlation experiments were performed on the $2^-(\beta_1)\ 2^+(\gamma)\ 0^+$ and $2^-(\beta_2)\ 2^+(\gamma)\ 0^+$ cascades, (where β_1 and β_2 denote the first-forbidden β-decays to the first and second excited 2^+ states of the daughter nucleus) in the decays of ^{76}As, ^{126}I, and ^{122}Sb. Similar experiments were performed on the $3^-\ (\beta_2)\ 2^+(\gamma)\ 0^+$ cascades in the decay of ^{124}Sb. These experiments show that $R_1(W)$ and $R_2(W)$, the anisotropy factors of beta-decays to the first and second excited states respectively, are different in all the above cases, and in the case of ^{122}Sb show different energy dependences. These beta decays populate the first two "vibrational" states of the even-even nuclei of ^{76}Se, ^{126}Xe, ^{122}Te and ^{124}Te. From the point of view of the vibrational model alone, it is difficult to understand the differences in $R_1(W)$ and $R_2(W)$ which indicate differences in the intrinsic structures of the first two excited states of these nuclei. In the case of ^{140}La experiments with the $3^-(\beta_1)\ 2^+(\gamma)\ 0^+$ and the $3^-(\beta_2)\ 4^+(\gamma)\ 0^+$ cascades also showed differences in $R_1(W)$ and $R_2(W)$. Beta-gamma directional correlation experiments were also performed in the $3^-(\beta)\ 3^-(\gamma)\ 2^+$ cascade in the decay of ^{124}Sb and the $4^+(\beta)\ 4^+(\gamma)\ 2^+$ cascade in the decay of ^{134}Cs. The beta-decays involved in these cascades are of the allowed type showing the unusually large log ft values of 7.2 and 8.9 respectively. Experiments show that the angular correlation coefficient $A_2(W)$ in both cases is zero within an experimental accuracy of 0.3 per cent. Beta-gamma circular polarization correlation experiments were performed at four different angles on the ^{122}Sb $(\beta_1)\ 2^+(\gamma)\ ^{122}$Te 0^+ cascade involving the 1.4-Mev beta group and the 0.56-Mev gamma ray. Results of angular dependence of the degree of circular polarization, P_c, show no evidence of the presence of a P_3 (cos θ) term confirming the absence of the $\langle\beta_{ij}\rangle$ matrix element in this beta-decay. From the value of $A_1(\beta) = (0.09 \pm 0.04)$ p/W the value of matrix element ratio y′ was derived to be $y' = 0.30 \pm 0.05$. (Dissertation Abstr.)

10093 NEUTRON INTERACTIONS WITH ^{40}Ar AND ANGULAR DISTRIBUTIONS OF GAMMA RAYS PRODUCED IN ^{40}Ar(n,n′γ)^{40}Ar REACTION [Thesis]. Mathur, Suresh Chandra. Austin, Tex., Univ. of Texas, 1965. 146p.

The cross section for ^{40}Ar(n,α)^{37}S was measured in the incident neutron energy range, 13.0 to 20.2 Mev. The cross section measurements were carried out with two independent techniques. In the first, a high pressure argon-filled gas scintillation spectrometer was utilized. From the disintegration spectra obtained by the neutron bombardment of argon gas, the cross sections for the (n,α), (n,αn) and (n,nα) reactions were determined. The second technique involved the activation of liquid argon samples by neutron bombardment and the measurement of the delayed gamma activity from ^{37}S. The experimental results were compared with the predictions of the compound nucleus theory of Weisskopf and Ewing. The theory accounted for the general features of the experimental results. The study of the neutron interactions with ^{40}Ar was continued in the energy range 3.0 to 4.5 Mev with the measurement of the gamma-ray spectrum produced in the ^{40}Ar(n,n′γ)^{40}Ar reaction. The excitation functions for the production of 0.68-, 1.08-, 1.45-, 1.77- and 2.53-Mev gamma rays at 90° were measured. The angular distributions and the absolute differential cross sections for these gamma rays were measured with incident neutron energies of 3.0 and 3.5 Mev.

The experimental results were compared with the predictions of the Hauser-Feshbach and the Satchler formalisms and excellent agreement was found. Spin and parity assignments of 2^+ for the third excited state (2.53 Mev) and 4^+ for the fifth excited state (3.22 Mev) in ^{40}Ar were made. The calculation of the angular distributions on the basis of Satchler formalism was carried out with the optical model parameters obtained by various authors. A comparison of the various calculated results has provided an insight into the validity of the several optical model potentials used. (Dissertation Abstr.)

10094 ELASTIC SCATTERING OF 28 Mev PROTONS FROM Al, Cu, Ag, AND Au, AND THE $^{19}F(p,\alpha)^{16}O$ AND $^{19}F(p,^3He)^{17}O$ REACTIONS AT 31 Mev [Thesis]. Dittman, Roger Roy. Los Angeles, Calif., Univ. of Southern California, 1965. 306p.

The total reaction cross sections of several nuclei were measured for 28-Mev protons. The differential elastic scattering cross sections of 28-Mev protons scattered from Al, Cu, Ag, and Au are presented from 15 to 150° (cms). Optical model analyses of the elastic scattering data were conducted using real and imaginary central potentials of the Woods-Saxon form, a surface imaginary potential in a Gaussian form, and a real spin-orbit potential of the Thomas form. Two distinct minimum values for chi-squared were discovered in the parameter space for copper when searches for the best fit to the experimental differential cross section were conducted. The best fits to the aluminum and silver angular distributions predicted reasonable values for the optical model parameters and a total reaction cross section within the error of the experimental value. A best fit to the gold angular distribution that predicted reasonable values for the optical model parameters and a total reaction cross section within the experimental error was obtainable when the surface absorption was held to zero. The $^{19}F(p,\alpha)^{16}O$ and $^{19}F(p,^3He)^{17}O$ reactions were studied using a dE/dx-E solid state detector telescope. The angular distributions of ^3He particles leading to the ground and first excited states of ^{17}O were measured from 17 to 111° (cms). The angular distributions showed strong forward peaking and pronounced maxima and minima. The total cross section for the (p,α) reaction was much less than the total cross section for the $(p,^3He)$ reaction leading to the ground state. The observed angular distributions were compared to predictions of plane wave direct interaction theories. A good fit to the $^{19}F(p,\alpha)^{16}O$ reaction was found with an angular momentum of zero and an interaction radius of 6 fermis. The larger $(p,^3He)$ total cross section was interpreted as indicating that the three nucleons outside the ^{16}O core in ^{19}F were more likely to cluster as a neutron plus a deuteron than as a triton. (Dissertation Abstr.)

10095 AN INVESTIGATION OF PROTON-NUCLEUS COLLISIONS AT 27 Bev [Thesis]. Gray, Garnett Greene. Lincoln, Neb., Univ. of Nebraska, 1965. 138p.

An experimental investigation of collisions of 27-Bev protons with nuclei of photographic emulsions was carried out. A mean-free-collision path of (38 ± 1.7) cm was found in the along-the-track scanning of the proton tracks. The events found in scanning were separated according to target mass. Of the events thus separated, central collisions having one and two nucleon masses as target were extensively investigated. From the central collisions having one nucleon as target, (4.76 ± 0.5) charged shower particles emerge, (79 ± 12) per cent of which are pions having an average energy (490 ± 75) Mev and average transverse momentum (274 ± 75) Mev/c, and which show forward-backward peaking in the distribution per unit solid angle in the center-of-mass system. From central collisions having two nucleons as target (6.64 ± 0.9) charged shower particles emerge, of which (77 ± 13) per cent are pions having nearly the same average characteristics as pions from collisions having one nucleon as target. Indications are that multiple-nucleon target collisions may occur with as many as two but not as many as three coherent target nucleons. The collision radiation time in the center-of-mass system is estimated to be between (0.38 and 0.76) × 10^{-23} sec. Predictions of the Fermi statistical theory are found to compare favorably with the experimental results when nucleon-antinucleon production is ignored, and the collision volume radius is taken to be $R_0 \sim 3.5(\hbar c/M_\pi c^2)$. (Dissertation Abstr.)

10096 A COLLECTIVE MODEL FOR NEGATIVE PARITY STATES IN EVEN-EVEN NUCLEI [Thesis]. Davidson, Melvin Gordon. Troy, N. Y., Rensselaer Polytechnic Inst., 1964. 122p.

A collective model based on the expansion of the nuclear surface in spherical harmonics of order three is developed, which attempts to explain properties of low-lying negative parity levels in even-even nuclei. This model is analogous to the asymmetric rotator model developed earlier for positive parity states and extended a short while later to include negative parity states. Both rotation and vibration of the nucleus are considered in a formalism that utilizes the hydrodynamic moments of inertia but with an adjustable mass parameter. This model differs from the above-mentioned negative parity work in that all of the possible seven degrees of freedom are retained in the parameterization whereas the previous model restricted the number to five by requiring that the body fixed axes be the principal axes. Because of the added degrees of freedom, it is found that the rotation eigenfunctions no longer display symmetry of the group D_2. This results in a considerably more complex level structure. Reduced transition probability ratios based on this model are also calculated. (Dissertation Abstr.)

10097 SIGNS OF BETA-MOMENTS AND EXPECTATIONS FOR THE ASYMMETRY PARAMETER IN BETA-EMISSIONS [Thesis]. Ley-Koo, Eugenio. Bloomington, Ind., Indiana Univ., 1964. 38p.

The isospin symmetries of the nucleons are incorporated into the j-j coupling shell model of the nucleus to derive purely theoretical predictions for the relative signs of the singlet and triplet moments, $\langle 1 \rangle$ and $\langle \sigma \rangle$. It is demonstrated that the beta-transitions between n-nucleon configurations in a given shell of equivalent nucleons, and between n-nucleon-hole configurations in the same shell and with the same quantum numbers, have triplet moments of the same magnitude but of opposite signs, relative to a phase convection that assures a given sign for the singlet moment. The results are predicted on the basis that consideration of just the pure shell model configurations is sufficient for determining the signs of the moments. In order to check on this, the relations known to exist between the magnitudes of the triplet moment are extended and the magnetic moments of the parent or daughter mirror states are extended to include the corresponding signs. The use of the measured magnetic moments in such relations is known to give magnitudes for $|\langle \sigma \rangle|$ in much closer agreement with observations than are the shell model values. It is found that the signs of the beta-moments obtained from the pure shell model and from the magnetic moments agree in every case, except for ^{35}Ar. This case is well known to have an anomalously small triplet moment. Since the theory developed here seems reliable for the signs of the beta-moments, no new attempt at obtaining more quantitatively accurate, purely theoretical values for their magnitudes is made. The ultimate results are predictions of the asymmetry parameters to be expected in the mirror decays, which are obtained with the help of the experimental ft-values of the mirror nuclei and of ^{14}O. (A.G.W.)

10098 ELASTICALLY SCATTERED POLARIZATION OF 40 Mev PROTONS FROM DEUTERIUM [Thesis]. Goldberg, Howard Simon. Berkeley, Calif., Univ. of California, 1965. 72p.

The polarization of the elastically scattered proton from deuterium at 40 Mev was measured and found to be large, reaching a maximum negative value of -0.392 ± 0.018 at $\theta_{cms} = 114$ deg and crossing over to positive values at backward cms angles. The results do not agree with the impulse approximation predictions of Kowalski and Feldman. After development of the density matrix formalism for a spin ½, spin 1 system, a phase shift analysis of the

data was made, using the elastic differential cross section results of Williams. To get a reasonably good fit to the data, F waves had to be included. This required a 26-parameter fit and for 62 data points gave a minimum χ^2 of 135. The large values of the mixing parameters in certain J states indicates the presence of tensor forces. (Dissertation Abstr.)

10099 DECAY SCHEME AND ANGULAR CORRELATION STUDIES IN ^{121}Sb [Thesis). Bishara, Bishara Atalla. Columbus, Ohio, Ohio State Univ., 1965. 145p.

The decay of ^{121}Te and ^{121m}Te to ^{121}Sb was studied by gamma-ray spectroscopy techniques. Gamma transitions having energies 38, 66, 470, 508, 574, 910, 1000, and 1107 kev were confirmed. The following coincidences were observed: 38–470, 910, 1000, 1107; and 66–470, 508. A consistent decay scheme having levels at 38, 508, 574, 948, 1038, and 1145 kev is confirmed. The half life of the 38-kev level, measured by the delayed coincidence method, is found to be $(3.8 \pm 0.2) \times 10^{-9}$ sec, while an upper limit of one nanosecond is set for the half lives of the 508-, 574-, and 1145-kev levels. The K-conversion coefficient of the 38-kev, measured by means of scintillation counters, is found to be 9.02 ± 0.51, which corresponds to a predominantly M1 transition. 511–511 kev coincidences were observed, with an intensity of about 0.002 ± 0.001% of the decay. A weak (0.002 ± 0.001)% positron branch and, consequently, a (2 ± 1)% electron capture branch from ^{121m}Te to the 38-kev state are proposed. Angular correlation measurements of the accessible cascades were made. These values were used with other available information to determine the following spin assignments: $^7/_2$ to the 38-kev state, $^3/_2$ to the 508-kev state, and $^1/_2$ to the 574-kev state. The assignment of spin $^{11}/_2$ to the 1107-kev state is favored although the $^9/_2$ and $^7/_2$ values cannot be completely excluded. These results indicate that the 38-kev transition is predominantly M1 with δ (E2/M1) = 0.009 ± 0.018, the 66-kev transition is (M1 + E2) admixture with δ (E2/M1) = 0.18 ± 0.03, the 470-kev transition is a pure E2 transition, the 508-kev transition is (M1 + E2) admixture with δ (E2/M1) = 0.29 ± 0.09, and 574-kev transition is pure E2. A comparison of the above results with the shell model and with the model based on quasi-particles and phonons indicates that the ^{121}Sb ground-state and the 38-kev state are quasi-particle states, while the 508-kev state consists primarily of one-phonon excitation coupled to the first excited state, and the 574-kev state is described by one phonon coupled to the ground state. (Dissertation Abstr.)

10100 THE HIGH ENERGY PHOTODISINTEGRATION OF ^{4}He [Thesis]. Asbury, Joseph George. Lafayette, Ind., Purdue Univ., 1965. 117p.

The cross section for the $\gamma + {}^4\text{He} \rightarrow d + d$ reaction was measured at photon energies of 221 and 265 Mev. With bremsstrahlung from the Purdue electron synchrotron incident on a liquid helium target, coincident deuterons were observed in two opposed counter telescopes. The forward deuterons were detected at a laboratory angle of 45° at each energy. Absolute differential cross sections were determined and the total cross sections, assuming a $\sin^2\theta \cos^2\theta$ angular distribution were calculated. The cross section for the $\gamma + {}^4\text{He} \rightarrow d + d$ reaction is $\sigma_{tot} = 22.3 \pm 7.9 \times 10^{-33}$ cm^2 at 221 Mev and $\sigma_{tot} = 5.4 \pm 3.8 \times 10^{-33}$ cm^2 at 265 Mev. These values were compared with the upper limits on the inverse process, $d + d \rightarrow {}^4\text{He} + \gamma$, and with theoretical estimates for the cross section for several different ^{4}He ground state wave functions. Data were also obtained for the photoproton emission from ^{4}He. The results were found to be consistent with the quasi-deuteron model proposed by Levinger. (Dissertation Abstr.)

10101 A STUDY OF THE FAST NEUTRON INDUCED GAMMA RAYS FROM CALCIUM [Thesis]. Tucker, William Eric. Austin, Tex., Univ. of Texas, 1965. 149p.

A study of the gamma rays produced by the interaction with natural calcium of fast neutrons in the energy range from 3.5 to 5.0 Mev is summarized. The incident neutrons were obtained through the D(d,n)^{3}He reaction with Texas Nuclear Corporation's 3 Mev Van de Graaff accelerator, and the resultant gamma ray spectra were recorded. The most prominent gamma rays observed were those with energies of 0.51, 0.768, 1.158, 3.73, and 3.90 Mev. The 0.51-, 3.73-, and 3.90-Mev gamma rays resulted from (n,n'γ) reactions in calcium-40. The 0.768-Mev gamma ray resulted from the ^{40}Ca(n,p'γ)^{40}K reaction with the reaction proceeding through the 0.798-Mev level in potassium-40. The 1.158-Mev gamma ray resulted from the ^{44}Ca(n,n'γ)^{44}Ca reaction. Other weaker gamma rays could be attributed to either (n,p'γ) and (n,α'γ) reactions in calcium-40, or (n,n'γ) reactions in calcium-44. Experimental gamma-ray angular distributions were measured for the prominent gamma rays at incident neutron energies of 4.20, 4.43, and 5.0 Mev. Gamma-ray production cross sections at θ (lab) = 90° were also measured for these gamma rays over the incident neutron range of 3.5 to 5.0 Mev. The experimental data obtained were well described, within experimental errors, by the Satchler formalism. This agreement supports the presumption that the predominant reaction mechanism involved is that of compound nucleus formation and further supports the validity of the basic postulates of statistical theory as they apply in this case. The results show the spin and parity of the 3.90 and the 4.48 Mev levels in calcium-40 to be 2^+ and 5^-, respectively. (A.G.W.)

10102 ENERGY AND ANGULAR DISTRIBUTION OF PHOTONEUTRONS FROM ^{18}O [Thesis]. Mughabghab, Said Fares. Philadelphia, Univ. of Pennsylvania, 1964. 124p.

The energy and angular distribution of photoneutrons from ^{18}O(γ,n)^{17}O are investigated. An ^{18}O target enriched to 90% is irradiated with bremsstrahlung of 20-Mev maximum energy from the University of Pennsylvania betatron. The photoneutrons are detected by recoil protons in 200-micron-thick K2 emulsions at angles between 20 and 150° with the beam. Distinct peaks in the neutron spectrum at 1.3, 1.7, 3.1, 5.5, 7.4, and possibly at 9.2 and 10.5 Mev are observed. The peaks at 1.3 and 3.1 Mev can be accounted for in terms of single particle excitation modes of the valence neutrons without disturbing the ^{16}O core. These correspond to energy levels in ^{18}O at 10.3 and 12.2 Mev. Most of the transitions are deduced to leave ^{17}O in excited states. The angular distribution of the neutrons is highly anisotropic at low energies. At high energies, there is an indication of interference effects between dipole and quadrupole absorption such that angular distribution is represented by $a + b \sin^2\Theta (1 + 0.5 \cos\Theta)^2$. (Dissertation Abstr.)

10103 ELASTIC AND INELASTIC NEUTRON SCATTERING BY SILICON AND SULFUR [Thesis]. Petitt, Gus A. Durham, N. C., Duke Univ., 1965. 130p.

The energy spectra of neutrons scattered by silicon and sulfur were measured using time-of-flight techniques. Measurements were made at nine equally spaced scattering angles at incident neutron energies of 2.45, 2.85, 4.00, 4.90, and 5.80 Mev. In order to measure the variation with energy of the scattering cross sections, data were taken for more closely spaced energy intervals at a scattering angle of 60°. Elastic scattering and inelastic scattering to the first excited states of these nuclei were observed. The elastic scattering angular distributions are compared with the predictions of the optical model. The non-local potential of Perey and Buck with the potential well depths reduced slightly from their original values describes the shape elastic component of the scattering well for high incident neutron energies where fluctuation effects are small. The inelastic scattering cross sections show large fluctuations, which are ascribed to interferences between the amplitudes of the many excited levels in the compound system, although the angular distributions remain fairly isotropic. The inelastic scattering cross sections of silicon are compared to the predictions of the Hauser-Feshbach formula both with and without the Dresner width fluctuation correction. On the average, the magnitudes of these cross sections lie between the predictions of the corrected and uncorrected formulas. This suggests that in the ^{29}Si compound nucleus $\langle \Gamma^{J\pi} \rangle \approx D_{J\pi}$ rather than $\langle \Gamma^{J\pi} \rangle \gg D_{J\pi}$, which is necessary for the corrected formula to hold. (Dissertation Abstr.)

10104 THE LEVEL SCHEME OF ^{69}Ga [Thesis]. Temperley, Judith Mary Kantack. Eugene, Ore., Univ. of Oregon, 1965. 123p.

The energy levels of ^{69}Ga were investigated by studying the gamma rays emitted following the beta decay of ^{69}Ge. The energies and intensities of the gamma rays observed using a lithium-drifted germanium detector are 237 kev (4.2), 320 kev (14), 511 kev (1000), 532 kev (3.2), 553 kev (7.6), 573.4 kev (166), 587 kev (2.7), 763 kev (2.1), 788 kev (4.8), 871.8 kev (131), 1052 kev (4.0), 1107.2 kev (372), 1206 kev (3.5), 1335 kev (41), 1349 kev (3.1), 1525 kev (1.7), 1576 kev (1.7), 1893 kev (2.6), 1922 kev (0.8), and 2023 kev (3.4). The intensities are relative to 1000 annihilation radiation gamma rays. Gamma-gamma coincidences were measured using two NaI(Tl) scintillation spectrometers and a fast-slow coincidence circuit with a resolving time of ten nanoseconds. The results permitted the construction of an unambiguous level scheme for ^{69}Ga with excited states occurring at 320 kev, 573.4 kev, 871.8 kev, 1107.2 kev, 1335 kev, 1525 kev, 1893 kev, 1922 kev, and 2023 kev. The half-life for the decay of ^{69}Ge was remeasured to be 35.5 ± 0.8 hours. The energies and spins of the levels of ^{69}Ga were calculated by assuming an intermediate coupling between the thirty-first proton and the remaining even-even core. The excited states for the ^{68}Zn core were those determined experimentally for this nucleus by other investigators and were assumed to be due to one- and two-phonon vibrational excitations. The single proton was restricted to the $2p_{3/2}$, $1f_{5/2}$, or $2p_{1/2}$ single-particle levels. Best agreement with the experimental results was obtained for single-particle spacings $E(p_{1/2}-p_{3/2})$ = 1.4 Mev, $E(f_{5/2}-p_{3/2})$ = 1.2 Mev, and a delta-function or Gaussian radial dependence for the core-particle interaction. Agreement was obtained for a reasonable value of the coupling strength. (Dissertation Abstr.)

10105 NEUTRON COMPOUND ELASTIC SCATTERING BY ^{208}Pb AT 3.15 Mev [Thesis]. Spahn, Carroll Joe. Austin, Tex., Univ. of Texas, 1965. 66p.

The differential compound-elastic scattering cross section of lead-208 for neutrons of energy 3.15 Mev was measured in order to lend further verification to the non-isotropy of this process as predicted by Hauser-Feshbach theory and to furnish further information on optical model parameters in this energy and mass number region. The cross section was obtained utilizing a substraction method with ordinary lead, uranium lead, and thorium lead from whence were extracted the differential elastic cross sections of lead-208, lead-206, and the differential compound elastic cross section of lead-208. The data were taken using fast neutron time-of-flight techniques to separate the elastically scattered neutrons from the inelastically scattered neutrons and from the gamma rays resulting from inelastic scattering. The resulting compound elastic cross section is definitely anisotropic and compares favorably to that obtained by Hauser-Feshbach type calculations based on optical model parameters. (Dissertation Abstr.)

10106 THE RELATIVE INTENSITIES OF INTERNAL CONVERSION LINES IN ^{137m}Ba AND ^{210}Bi. Velinskv, L. J. (Michigan State Univ., East Lansing. Albion Coll., Mich.); Velinsky, M. A.; Haynes, S. K. 10p. (CONF-650563-4). ORINS, Gmelin, AED-CONF-65-117-6.

From International Conference on the Internal Conversion Process, Nashville.

The internal conversion spectrum of ^{137m}Ba was examined under high resolution. The relative intensities of the conversion lines with previous theoretical values are given. Also the conversion spectrum of ^{210}Bi was examined. The conversion electron spectrum of lead-210 is shown, and the relative intensities of the bismuth-210 conversion lines are given. In the low-energy region of this spectrum, it appears that there is a trend toward a progressive failure of the empirical screening correction. (J.F.P.)

10107 ON CERTAIN IRIDIUM AND PLATINUM ISOTOPES SATURATED WITH NEUTRONS. Dupetit, G. A.; Baro, G. B.; Viirsoo, M.; Flegenheimer, J. (Comision Nacional de Energia Atomica, Buenos Aires). pp 241-3 of Primera Conferencia Interamericana de Radioquimica. Washington, D. C., Union Panamericana, 1965. (In Spanish).

In order to study the isotopes of iridium and platinum with neutron excess, natural and enriched platinum and gold were irradiated with fast neutrons. The β activity and the γ spectra were determined for both the gold and the platinum. In the irradiated platinum periods of 2.3 hr (^{195}Ir) and 19 hr (^{194}Ir) were observed. The 9-day period attributed to ^{196}Ir was not detected. In the case of gold a period of 84 min was observed. It was determined that the correct value of the period of the isomer of ^{197}Pt is 1.3 hr and not 1.3 min as recorded previously. (J.S.R.)

10108 SERIES OF ISOBARS WITH MASS NUMBER 189. Flegenheimer, J.; Baro, G. B.; Viirsoo, M. (Comision Nacional de Energia Atomica, Buenos Aires). pp 251-4 of Primera Conferencia Interamericana de Radioquimica. Washington, D. C., Union Panamericana, 1965. (In Spanish).

The bombardment of natural Os with fast neutrons produces a β emitter in a tungsten fraction within a period of 11 min. From the production of the 23-hr Re by fast-neutron bombardment of ^{190}Os, bombardment of ^{192}Os with 28-Mev deuterons, the bombardment of ^{192}Os with fast neutrons, and the decay of ^{189}W, it was concluded that the 11-min tungsten isotope has the mass number of 189. (J.S.R.)

10109 RELATION BETWEEN THE EFFECTIVE CROSS SECTIONS OF ^{134m}Cs and ^{134}Cs PRODUCED IN NUCLEAR REACTION ^{133}Cs(d,p)^{134}Cs. Mocoroa, A.; Vignau, H.; Nassiff, S. J. (Univ. Nacional de La Plata, Buenos Aires. Comision Nacional de Energia Atomica, Buenos Aires). pp 255-8 of Primera Conferencia Interamericana de Radioquimica. Washington, D. C., Union Panamericana, 1965. (In Spanish).

Cs in the form of CsCl was irradiated with deuterons at 28.1 Mev. The Ba formed was separated chemically and the γ spectrum was measured. The ratio between the cross sections were determined as a function of the deuteron energy. The results are shown graphically and in tables. A slight increase in the population of the level with the highest spin was observed. (J.S.R.)

Plasma Physics and Thermonuclear Processes

See *also* Fluid Physics and Thermodynamics

Refer also to abstract 9222.

10110 (AERE-M-1474) ELECTRICAL CONDUCTIVITY OF INERT GAS-ALKALI METAL PLASMAS WITH ELEVATED ELECTRON TEMPERATURES. Ellington, H. I. (Atomic Energy Research Establishment, Harwell (England)). Oct. 1964. 20p. Dep. mn.

The theory of the electric conductivity of a plasma consisting of a heated inert gas at or above atmospheric pressure, seeded with a small amount of alkali metal vapor is given. The processes leading to elevation of the electron temperature are discussed, and the value of the electron temperature calculated by an energy balancing process. The relevant plasma parameters, such as the number densities of the various species, and the electronic collision time and mean free path are calculated. A discussion of the newly-derived, non-equilibrium Saha equation, and its use in the determination of the degree of ionization of a two-temperature plasma is given. The importance of taking into account the scattering of electrons by positive ions when calculating the electron temperature (and hence the ionization), as well as when calculating the electronic mobility, is stressed. Theoretical conductivity/current density curves for a particular plasma are given, and the differences between those produced by the present analysis and by previous theories are demonstrated. The effect of the uncertainty in the various electronic collision cross sections on the theoretical curves is shown. Finally, the theory is applied to some experimental results, and a comparison of the present and previous theories is again made. (auth)

10111 (CEA-R-2853) MESURE DE L'ENERGIE DES PARTICULES D'UN PLASMA A L'AIDE DE LA SONDE PYROMETRIQUE POLARISEE. (Measurement of the Energy of Plasma Particles With a Biased Pyrometric Probe). Geller, Richard (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Oct. 1965. 16p. Dep. mn.

The use of a biased pyrometric probe, a Langmuir probe made of carbon or tungsten, in the measurement of the energy of plasma particles is discussed. For hot and dense plasmas, the radiation power of the probe is compared with the product of the current and voltage of the characteristic curve. (D.C.W.)

10112 (CONF-650512) PROCEEDINGS OF THE 1965 SYMPOSIUM ON ENGINEERING PROBLEMS OF CONTROLLED THERMONUCLEAR RESEARCH, MAY 4-7, 1965. (Lawrence Radiation Lab., Univ. of California, Livermore). Contract W-7405-eng-48. 247p. Dep. mn; CFSTI $6.00 cy, $1.25 mn.

Separate abstracts were prepared for 29 of the 41 included papers. The remaining papers appeared previously in NSA as: 19: 39966, 39971, 40844, 43405, 43415, 46718, and 47121 and 20: 505, 1276, 2014, 2522, and 3178. (M.O.W.)

For abstracts of individual papers see: 9133–9135, 9216–9219, 9598, 9888, and 10113–10132.

10113 (CONF-650512, pp 27-30) THE PRODUCTION OF "EXCITED STATE" H_2^+ FOR LORENTZ DISSOCIATION IN DCX-1. Edwards, R. S. (Oak Ridge National Lab., Tenn.).

The details of obtaining an H_2^+ beam in excited states from H_3^+ produced in a duoplasmatron ion source are presented. The beam is used for Lorentz dissociation to create a 300-kev plasma within DCX-1. The optimum source conditions necessary to extract large H_3^+ currents from duoplasmatrons, the electrostatic method used to neutralize these large currents to obtain parallel beams over long distances, the construction of a water vapor conversion cell, and the remaining ion optics are all discussed in detail. (auth)

10114 (CONF-650512, pp 31-4) SUSTAINED-FIELD THETA PINCH. Westendorp, W. F. (Research Lab., General Electric Co., Schenectady, N. Y.).

A sustained-field theta pinch device is described which will contain plasma longer than 20 μ sec and possibly as long as several milliseconds. (M.O.W.)

10115 (CONF-650512, pp 35-43) THE CHALICE FAST, HIGH-VOLTAGE PLASMA BANK. Yevick, G. J.; von Voros, G.; Opat, H.; Nyland, H.; Southworth, R. (Stevens Inst. of Tech., Hoboken, N. J.).

Some new features in the design and construction of a fast 80-kJ, 50-kv main bank for Chalice Mark II are discussed. The operating characteristics and performance of this bank are now being tested. The bank is divided into two halves, each half comprising 32 μF capacitance. Low inductance is achieved by the use of parallel plate transmission lines and collector plates. The solution to the difficult problem of high frequency corona is discussed. In the design of very low inductance series and crowbar switches, the rupturing of a dielectric by exploding wires was used. Here the problems are very low inductance, simultaneity of closing, very low resistance, and no damage. Multiple parallel channels minimize the arc damage and lower the inductance. (M.O.W.)

10116 (CONF-650512, pp 48-51) RELIABILITY OF THE ASTRON ACCELERATOR. Saunders, K. A. (Lawrence Radiation Lab., Univ. of California, Livermore).

The reliability of the Astron accelerator is considered as a function of only those components directly related to the production of the electron beam. The method of acquiring and processing the data is presented. This data is reduced to show reliability and ease of maintenance for each of the major component categories as well as for the system. This information is also carried on to show the system availability for the average conditions of past operation. The present reliability figures are compared with previous predictions. To add insight into future operation, an attempt is made to predict the system availability at varying stress levels of voltage and pulse repetition rate. (auth)

10117 (CONF-650512, pp 57-62) PHAROS CROWBAR SYSTEM. Young, M. P. (Naval Research Lab., Washington, D. C.).

The clamp system now in operation on the Pharos magnetic compression experiment is described. Clamping the circuit at the current maximum (15 Ma at ~20 μsec) converts the normal damped oscillatory waveform to an exponential decay, thus increasing the duration of the effective magnetic field to approximately 180 μsec. The clamp switches are a variation of the air trigatron starting switch except they are housed in a commercial Pyrex tee and evacuated to 1 mtorr. The tungsten-copper electrodes with a 10-M gap will hold off the 20-kv bank voltage at this pressure and yet trigger reliably at the low voltage as required. The required pressure level is maintained by a single, uncomplicated, large vacuum system with a common manifold distributed over the condenser bank to all clamp switches. The electrodes, housing, and expansion chamber are assembled with O-ring vacuum seals, allowing the rapid interchange or replacement of switch components. The trigger pin assemblies are identical to those used for the air-gap starting switches. (M.O.W.)

10118 (CONF-650512, pp 63-7) ELECTROLYTIC CAPACITOR BANKS. Hopkins, Donald B. (Lawrence Radiation Lab., Univ. of California, Berkeley).

A series string of electrolytic capacitors has been proven to be a reliable energy-storage unit. Considerations of the theory, design, and usage of low- and high-voltage banks are discussed. Basic electrolytic capacitor properties are reviewed, several particular banks are discussed, then possibilities for future development are examined. (auth)

10119 (CONF-650512, pp 91-5) A HIGH-SPEED DATA ACQUISITION SYSTEM. Bennett, F. K.; Klotz, C. G. (Princeton Univ., N. J. Plasma Physics Lab.).

Analog-to-digital conversion and ferrite core storage were chosen as the basic ingredients of the data acquisition system described. The system consists of a 16-channel multiplexer, an 8-bit analog-to-digital converter, a 4096-word coincident-current memory, an IBM-compatible tape transport, an oscilloscope display, and the associated timing and control unit. (M.O.W.)

10120 (CONF-650512, pp 100-4) HIGH-ACCURACY MEASUREMENTS OF LARGE DC PULSE CURRENTS. Spinner, J. W. (Princeton Univ., N. J. Plasma Physics Lab.).

A current-metering system was developed to measure the magnetic field strength of the confining field in the C Stellarator to an accuracy of ±0.1%. At present the field current is pulsed to 36,000 A for 1 sec once every 40 sec. The maximum allowable current is 44,600 A. Measurement of the pulse current at any point in the waveform is accomplished by measuring the voltage drop of a metering shunt. This signal is amplified and sampled by an A/D converter. The system floats at ±400 v to ground and is isolated to withstand a ±5-kv fault voltage to ground. By means of a suitable isolation device the reading is displayed on a remote decimal readout and is transmitted to an IBM card punch. (M.O.W.)

10121 (CONF-650512, pp 105-8) SYSTEM FOR MONITORING PULSE VOLTAGES ON MAGNETIC CORES IN THE ASTRON ACCELERATOR. Steinmetz, L. L. (Lawrence Radiation Lab., Univ. of California, Livermore).

Because of the large size and complexity of the system (74,000 components, plus 1 million feet of RG cable), effective operation of the Astron gun and accelerator depends heavily upon electronic monitoring. A system is described which simultaneously monitors 333 magnetic core pulses (12 to 16 kv at 0.4 μsec duration) in a parallel-to-serial operation. The monitor system has two modes of operation: to determine whether the core pulses are within ±5% (or ±10%) of the normal pulse in integrated area, or to determine which of the 423 thyratron modulators may be prefiring. This system is used to detect component failure and modulator timing drift and can be operated by one electronics technician. (auth)

10122 (CONF-650512, pp 109-11) A METHOD FOR THE CONTINUOUS MEASUREMENT OF PLASMA POTENTIAL USING A CONSTANT CURRENT, LITHIUM-ION-BEAM TRANSMISSION TECHNIQUE. Waugh, A. F.; North, G. G. (Lawrence Radiation Lab., Univ. of California, Livermore).

A method is described for continuously measuring a positive plasma potential over the range from 100 v to 5 kv. The time resolution of the measurement is approximately 0.5 msec. A constant-current regulator system is used to vary the energy of thermionically emitted lithium ions so that a preselected lithium ion current level is maintained through a mirror-field-confined plasma region into a Faraday collector cup. This method results in the energy of the lithium ions (applied accelerating voltage) being held equal to the instantaneous value of the varying plasma potential (net voltage of the confined plasma with respect to ground). (auth)

10123 (CONF-650512, pp 128-30) SOME USEFUL TECHNIQUES IN THE DESIGN OF MULTIPOLAR WINDINGS IN CLOSED SYSTEMS. Wakefield, Kenneth E. (Princeton Univ., N. J. Plasma Physics Lab.).

Magnetic and mechanical design techniques which should be useful in developing many of the multipolar windings now being considered throughout the world are discussed. Described are magnetic design procedures and related computer programs which ensure that the spatial arrangement of the conductors will achieve the purposes of the configuration, which usually are expressed in terms of certain magnetic field parameters. Problems encountered in devising conductor arrangements producing these beneficial effects are discussed, and ways in which one might resolve these problems are presented. (M.O.W.)

10124 (CONF-650512, pp 131-7) MECHANICAL DESIGN AND CONSTRUCTION OF THE ALICE MIRROR AND QUADRUPOLE MAGNETS. Harvey, Arthur R. (Lawrence Radiation Lab., Univ. of California, Livermore).

A number of basic design and fabrication difficulties were encountered in the construction of series I and II Alice mirror magnets. A stage-by-stage photographic record was assembled during the construction of these magnets. An analysis of structural weaknesses of the coils was made from their operational history. The quadrupole magnets were then designed and constructed on the basis of conclusions derived from this analysis. (auth)

10125 (CONF-650512, pp 142-5) BEAM INFLECTORS FOR THE ASTRON MACHINE. Ryan, James F. (Lawrence Radiation Lab., Univ. of California, Livermore).

Design and construction methods are given for two types of beam inflectors used to take the external electron beam through the main magnetic field and into the confinement chamber of the Astron machine. One inflector uses five concentric tubular conductors with sinusoidal current distribution (obtained by varying wall thickness as a function of the cosine of the angle, going around the tube) to cancel the prevailing main field inside the inflector without perturbing it outside. The other uses a central tube of high permeability and a single tubular conductor with sinusoidal current distribution to correct the perturbation in the external field caused by the permeable tube. The average remaining field inside the inflector is only 0.4% and 0.1%, respectively, for the two types. Both inflectors use diverted turns of the main solenoidal field coils to power the canceling or correcting fields. A method is given for producing sinusoidal current sheets by electroforming and ordinary lathe work. (auth)

10126 (CONF-650512, pp 162-7) DEVELOPMENT OF AN INTERLEAVED, FRACTIONAL-TURN COIL. Dike, R. S.; Kemp, E. L.; Marshall, J. (Los Alamos Scientific Lab., Univ. of California, N. Mex.).

The theta pinch at Frascati, Italy, obtains high voltages by connecting six 20-kV capacitor banks in series at equal intervals around a one-turn coil. At Jülich, Germany, the collector plate feeding a one-turn coil is split into many parallel sections. This lowers the inductance of the collector plate and greatly alleviates the problem of containing the large magnetic forces created by peak currents of many kiloamperes flowing through the collector into the coil. Both of these concepts were combined in the coil discussed here, to generate an interleaved, fractional-turn coil design. The design is explained and the current flow in the coil is discussed. A quarter-turn, 9-in.-diam, 11-in.-long coil was built and connected to four 25-kv banks having a combined energy of 25 kJ. The system produced 63 kv theta voltage around the coil and generated 13 kG rising in 1.6 μsec. This coil is shown and the mechanical and electrical advantages are discussed. (auth)

10127 (CONF-650512, pp 168-72) MINIMUM-B FIELD GENERATED BY "BASEBALL SEAM" CONDUCTOR. Pittenger, Lee C. (Lawrence Radiation Lab., Univ. of California, Livermore).

Computer calculations were made of the magnetic field produced by a conductor shaped like the seam of a baseball. The resulting field has a minimum value at the origin. Mirror ratios and minimum field values are found to vary with the angle subtended by the lobes of the conductor at the origin. Injection paths for neutral particles which parallel the field lines at entry are found to give different trapping lengths and ionizing field strengths for various entry angles. A conductor approximating the baseball seam shape is being built of arcs and straight-line segments. A field and force analysis of this real magnet is made which shows that the effects of making this approximation are roughly the same as produced by lessening the lobe angle. The effect of generating the curve on an oblate or prolate spheroid is investigated also. (auth)

10128 (CONF-650512, pp 177-81) DISSIPATION OF HEAT FROM LARGE-SCALE CTR APPARATUS AT ORNL. Wright, W. L. (Oak Ridge National Lab., Tenn.).

At ORNL a cooling water system dissipates heat generated in the solenoids that produce magnetic fields for CTR experimental purposes. In general, this system consists of: a forced-draft cooling tower capable of dissipating 170×10^6 Btu/hr, a dual-pressure closed loop that circulates demineralized water having a specific resistance greater than 3 MΩ-cm, at a rate in excess of 20,000 gpm at full capacity, and filtering equipment that deionizes and deoxygenates the water. The design criteria for the quality of the water are discussed, as related to the unique requirements of the experimental equipment being cooled. In particular, the water characteristics discussed are the specific electric resistance, the total solid content, and the dissolved oxygen content. Details are also given for maintaining the quality of the water in a closed-loop circulating system by means of diverting a slipstream through a filtering system and mixed-bed, deionizing, deoxygenating units. Flow diagrams and associated instrumentation for the demineralizing sections of the cooling loop are shown. (M.O.W.)

10129 (CONF-650512, pp 182-7) TARGETS FOR THE ASTRON 600-MW ELECTRON BEAM. Ryan, James F. (Lawrence Radiation Lab., Univ. of California, Livermore).

Water-cooled aluminum targets used to locate and measure the 4-Mev, 150-A electron beam are described. Average power of 1200 w and pulse power of 600 Mw are handled by a movable three-slat target 2 in. in diameter. Examples of melting and spalling on targets of aluminum, copper, and tantalum are shown. (auth)

10130 (CONF-650512, pp 188-92) ASTRON ELECTRON GUN. Hurley, Charles A. (Lawrence Radiation Lab., Univ. of California, Livermore).

An electron gun is described that will supply a 200-A, 720-kev electron beam to the Astron accelerator. The heart of the gun consists of an accelerating column that includes a 10-in. oxide-coated cathode and a 13-in. vacuumtight ceramic tube with 15 copper electrodes that pass through the ceramic wall. Several of the mechanically oriented problems encountered in the design of this apparatus are the fabrication of the ceramic-to-metal accelerating column, the cathode and grid design, the cooling system and the method of electrically insulating 16 kv in tightly packaged components. (M.O.W.)

10131 (CONF-650512, pp 201-12) HIGH-Q CAPACITOR DEVELOPMENT. Mather, N. W. (Princeton Univ., N. J. Plasma Physics Lab.).

Energy storage capacitors having high Q are required in the r-f circuitry associated with a pulsed, low-frequency magnetic pumping system under development for plasma heating experiments on the model C Stellarator. A program was instituted to develop, with the cooperation of those manufacturers who were interested, suitable high-Q capacitors. The individual units obtained as a result of this program were assembled in groups. Each group is an assembly totaling 0.5 μF at 120 kv, with self-resonant frequency greater than 300 kc. The Q of the assemblies from one manufacturer is nearly 400, and it is about 500 for the assemblies of the other manufacturer (both at 100 kc). The units are now under test in a ringing circuit but at present, because of limitations in connecting cables, charge voltages have been limited to 100 kv. Circuit Q's of 135 were achieved at 52 kc and 102 at 90 kc, exclusive of spark gap losses in both cases. Some of the results from this program are discussed. (M.O.W.)

10132 (CONF-650512, pp 213-20) ENERGY SUPPLY FOR A HIGH-POWER, PULSED, LOW-FREQUENCY RF GENERATOR. Turitzin, N. M. (Princeton Univ., N. J. Plasma Physics Lab.).

The design of an energy storage supply of 1.6 MJ capacity, arranged as a pulse forming network and capable of delivering a d-c pulse of about 2800A at 50kv for 10 msec duration once every 30 sec is described. Problems discussed include transient suppression, false firing of ignition switches, suppression of voltage overshoot at the load because of pulsing, arrangement of crowbars for load protection and reduction of oscillations within the pulse forming network caused by crowbarring, limitation of length of the output pulse, filtering of voltage fluctuations because of class B operation of supply load, and glow discharge behavior of ignitron switches. (auth)

10133 (CONF-650562-2) INSTABILITIES INDUCED BY PARTICLE COLLISIONS IN CONFINED PLASMAS. Coppi, Bruno (California Univ., La Jolla, San Diego). [1965]. Contract AT(11-1)-34. 22p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

From Conference on Non Equilibrium Thermodynamics, Chicago.

The effects of particle collisions on the stability of a confined plasma is studied considering a horizontal plasma layer supported in a gravitational field by a horizontal magnetic field. Magnetic fields with the same direction at all points are considered as well as sheared magnetic fields. It is shown that for these two cases the stabilizing effects of a finite ion gyration radius and the sheared magnetic field, respectively, become ineffective if the particle collisions are taken into account. (D.C.W.)

10134 (INR-616/IXa/PP) A NEW DERIVATION OF KINETIC EQUATION FOR INHOMOGENEOUS PLASMA. Kuszell, A. (Institute of Nuclear Research, Warsaw (Poland)). Mar. 1965. 22p. Dep.

The kinetic equation for nonuniform plasma is derived from the Liouville equation by the Prigogine-Balescú diagram technique. The obtained equation is equivalent to the equation derived previously but has a little simpler form. The equation has a non-Markoffian form and is valid in both stable and unstable cases and for long and short times. Its explicit form is obtained by using the Resibois summation procedure. The limiting form of the equation for long times in the stable case is derived. (auth)

10135 (IPPJ-37) ION CYCLOTRON RESONANCE HEATING OF AN INHOMOGENEOUS PLASMA COLUMN. Tanaka, Masatoshi (Institute of Plasma Physics, Univ. of Nagoya (Japan)). Sept. 1965. 33p. Dep. mn.

The ion cyclotron wave is generated in a plasma by an induction coil (Stix-type coil) wrapped around the plasma column. The absorbed r-f power spectrum is estimated on the basis of the linearized Vlasov-Maxwell equations by taking into account the variations of plasma density and ion temperature over the cross section of the plasma cylinder. Numerical calculations are made for the values of parameters of the QP plasma experiment assuming the density distribution of a parabolic type. (auth)

10136 (IPPJ-40) NEGATIVE CONDUCTIVITY IN PARTIALLY IONIZED GASES. Tanaka, Shigetoshi; Honzawa, Tadao; Takayama, Kazuo (Institute of Plasma Physics, Univ. of Nagoya (Japan)). Oct. 1965. 15p. Dep. mn.

The amplification of radio-frequency signal was observed in partially ionized gases, having large Ramsauer effect, in the absence of magnetic field. When the d-c grid current was adjusted, a strong attenuation, an amplification of the applied r-f signal, and strong emission with no input signal were observed. This phenomenon occurred when the working frequency was in the range from about 10 to 70 Mc which was somewhat smaller than the collision frequency of plasma electrons. It is considered that experimental results are interpreted as a phenomenon of the negative conductivity due to bremsstrahlung in plasmas. (auth)

10137 (IPPJ-41) NON-LINEAR MOTION OF TWO ION STREAMS IN A BACKGROUND OF HIGH TEMPERATURE ELECTRONS. Taniuti, Tosiya; Yajima, Nobuo; Outi, Akizi (Institute of Plasma Physics, Univ. of Nagoya (Japan)). Oct. 1965. 26p. Dep. mn.

Nonlinear ion acoustic waves propagating in a plasma of warm electrons and one or more streams of cold ions are investigated. A hydrodynamical model which employs ion fluid streams interacting among themselves through the electron pressure gradient is used, isothermal electrons are assumed. Though the model assumes charge neutrality, it enables us to show how large amplitude disturbances become steeper, tending to form shocks or inversely how discontinuous initial disturbances are smoothed out. For a single fluid, the behavior is the same as that of isentropic gas with γ equal to unity. However for multicomponent cases there exist conspicuous properties such as multi-stream instabilities. All these effects are discussed for the case of two streams. Simple waves are obtained by means of the method of characteristics; for the wave propagating faster than all the ions the compression leads to shock formation while the expansion leads to the instability, for the wave slower than all the ions the expansion leads to the shock formation and at the same time to instability and for the wave propagating with intermediate speed the situation is more complicated. (auth)

10138 (IPPJ-43) COLLISION-INDUCED INSTABILITY IN A MAGNETOACTIVE PLASMA. Shimomura, Noboru; Mitani, Kenji; Tanaka, Shigetoshi (Institute of Plasma Physics, Univ. of Nagoya (Japan)). Nov. 1965. 33p. Dep. mn.

The dispersion relations for the waves propagating in a magnetoactive plasma are obtained from the Boltzmann equation with a collision term of the electrons. Two cases in which the wave vector is parallel and perpendicular to a uniform magnetic field are studied. Assuming a δ-function for velocity distribution function, in each case, two dispersion relations for the zeroth approximation in k were obtained. (auth)

10139 (LA-DC-7381) THE INTERPRETATION OF CESIUM SPECTRA. Agnew, Lewis (Los Alamos Scientific Lab., Univ. of California, N. Mex.). [1964]. Contract W-7405-eng-36. 10p. (CONF-651049-1). Dep. mn. CFSTI $1.00 cy, $0.50 mn.

From IEEE Thermionic Conversion Specialist Conference, San Diego, Calif.

A review of the methods of plasma diagnosis by the interpretation of the cesium spectrum is given. Since accurate analysis of spectroscopic results depends on knowledge of the fundamental radiative properties of cesium, attention is called to recent experimental results for oscillator strengths and radiative recombination. Accurate analysis depends also on knowledge of the equilibrium properties of the plasma which is discussed in some

detail, especially the concept of local thermodynamic equilibrium. Molecular effects are also discussed and molecular absorption results are given. Certain refinements in experimental method and analysis are mentioned. (auth)

10140 (MATT-391) TOROIDAL VACUUM FIELD WITH MINIMUM VARIATION OF $\int dl/B$. Gardner, C. S. (Princeton Univ., N. J. Plasma Physics Lab.). Dec. 1965. Contract AT(30-1)-1238. 56p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

The effectiveness of scallops or periodic bulges of the field in reducing the variation of the specific flux of a magnetic line across a toroidal tube is studied. (D.C.W.)

10141 (MATT–428) RADIATION FROM PLASMAS. Dawson, John M. (Princeton Univ., N. J. Plasma Physics Lab.). Dec. 1965. Contract AT(30-1)-1238. 69p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

Only the processes which give rise to bremsstrahlung (charged particle encounters) and to cyclotron and synchrotron radiation from plasmas were considered. A discussion is presented on black body radiation, its density inside a plasma, and absorption and emission coefficients in terms of collision times. (M.O.W.)

10142 (MPI-PAE/P1.12/65) PRODUCTION AND BEHAVIOUR OF A MAGNETICALLY STABILIZED HIGH-DENSITY HIGH-TEMPERATURE PLASMA. Wulff, H. (Max-Planck-Institut fuer Physik und Astrophysik, Munich (West Germany)). Aug. 1965. 11p. (CONF-650806–20). Dep. mn.

From 7th International Conference on Phenomena in Ionized Gases, Belgrade.

In a newly developed linear device a plasma is produced and stabilized magnetically for a length of up to 70 cm and for a total discharge time of 2 msec during which the plasma current and the magnetic field strength are kept constant. Depending on the magnetic field strength, plasma current, contamination of the plasma and other parameters the plasma appears in a steady or an unsteady state. It does not come into contact with the wall in either case. The electron density obtained is about 10^{16} cm^{-3}, the maximum temperature exceeding 200,000°K. (auth)

10143 (MPI-PAE/P1.13/65) STARK BROADENING OF THE PASCHEN LINES. Vidal, C.-R. (Max-Planck-Institut fuer Physik und Astrophysik, Munich (West Germany)). Aug. 1965. 17p. (CONF-650806–19). Dep. mn.

From 7th International Conference on Phenomena in Ionized Gases, Belgrade.

The Stark broadening of the Paschen lines ($6 \leq n \leq 13$) was measured photoelectrically with an accuracy of 5% at an electron density of 1.3×10^{13} cm^{-3}. It was found that the impact broadening of the electrons has only a very small influence on the broadening of the lowest measured series members. The measured profiles are slightly narrower than quasistatic profiles which take into account the mutual interaction of the disturbing particles and which are smeared out in the line center, maintaining normalization. (auth)

10144 (NASA-TN-D–3051) VOLUME AND SURFACE INSTABILITY IN SLIDING PLASMAS. Talwar, S. P. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Dec. 1965. 19p. CFSTI $1.00 cy, $0.50 mn.

The electrostatic instability arising due to a tangential discontinuity of velocity in two semi-infinite, homogeneous regions of a cold and collisionless plasma subject to a uniform magnetic field is investigated by use of two fluid equations. A general dispersion relation is derived allowing for interstreaming of charged particles in each region in addition to a slippage of one region over the other. Special cases are then discussed and the criteria for stability, monotonic instability and growing wave instability are derived. (auth)

10145 (NASA-TN-D–3164) NONADIABATIC PARTICLE LOSSES IN AXISYMMETRIC AND MULTIPOLAR MAGNETIC FIELDS. Roth, J. Reece (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Dec. 1965. 73p. CFSTI $3.00 cy, $0.75 mn.

An analytical and experimental study of the nonadiabatic behavior of a single nonrelativistic charged particle in a magnetic field is presented. Two magnetic field geometries were considered; an axisymmetric magnetic mirror, which was investigated by both analytical and experimental means, and a minimum-B configuration formed by the superposition of a multipolar (Ioffe) magnetic field on an axisymmetric magnetic mirror, which was studied only by analytical means. The nonlinear equations of motion for a charged particle in these magnetic field configurations were solved for 10^5 sets of initial conditions on a high-speed computer. A particle was considered to be nonadiabatic if its adiabatic invariant $M_4 \sim v_\perp^2/B$ varied by more than 5 percent during a single interaction with the magnetic mirror in question. By defining suitable dimensionless similarity parameters, it was found possible to summarize the computer results in a single analytical expression, which predicts the conditions under which nonadiabatic behavior will be observed. This similarity relation is a useful substitute for a closed-form solution to the nonlinear and nonholonomic mathematical problem, and may be used as a basis for correlating experimental data. An experiment was devised to detect the enhanced particle losses resulting from nonadiabatic particle motion in an axisymmetric magnetic mirror. The results from a wide range of experimental conditions were plotted in terms of the similarity parameters found useful in correlating the analytical results and were found to obey the same similarity relation, but with different values of the constant parameters. This experimentally determined similarity relation gives the conditions for the onset of nonadiabatic losses in terms of the mirror ratio, particle energy, distance between mirrors, etc. This relation may be used as a design criterion to assure adiabatic confinement in axisymmetric magnetic mirrors of practical interest. (auth)

10146 (NP–15768) ISSLEDOVANIE ENERGETICHESKOGO RASPREDELENIYA VODORODNOI PLAZMY KOAKSIAL'NOGO ISTOCHNIKA. (Study of Energy Distribution of Hydrogen Plasma of a Coaxial Source). Zolototrubov, I. M.; Rastrepin, A. B.; Skoblik, I. P. (Akademiya Nauk Ukrainskoi SSR, Kharkov. Fiziko-Tekhnicheskii Institut). 1964. 12p. Dep. mn.

An experimental investigation was carried out on the energy distribution of a hydrogen plasma from a coaxial gun as a function of the time of delay between the opening of the valve and the delivery of voltage to the electrodes, for positive and negative polarities of the internal electrode. The times of formation of plasma clusters in the beam under these conditions were also determined. It was shown that, in the first quarter of the period of the current, ions with energies up to 20 kev were generated for delays of 85 to 100 μsec, independent of the electrode polarity. For delays from 120 to 285 μsec the operating regime of the beam depended on the electrode polarity to a significant extent. (tr-auth)

10147 (NP–15795) INZHEKTSIYA CHASTITS V ZERKAL'NUYU LOVUSHKU S NARASTAYUSHIM POLEM V PROBKAKH CHEREZ MAGNITNUYU LOVUSHKU OSTROUGOL'NOI GEOMETRII. (Injection of Particles into Rising-Field Mirror Trap Through Magnetic Trap Having Acute-Angle Geometry). Sinel'nikov, K. D.; Khizhnyak, N. A.; Repalov, N. S.; Zeidlits, P. M.; Yamnitskii, V. A.; Azovskaya, Z. A. (Akademiya Nauk Ukrainskoi SSR, Kharkov. Fiziko-Tekhnicheskii Institut). 1964. 14p. Dep. mn.

The passage of charged particles through a trap with a magnetic field of acute-angled geometry, injected through an end-type gap parallel to the magnetic-field axis, is studied. Conditions are found for the passage of particles with large and small displacement of the center of rotation of the particle from the magnetic axis. Conditions for the capture of these particles in a mirror trap conjugate to a trap with acute-angled geometry during the increase of the magnetic field in the traps are investigated. (tr-auth)

10148 (NYO-3578-2) PRODUCTION OF PLASMAS FOR THERMONUCLEAR RESEARCH BY LASER BEAM IRRADIATION OF SOLID PARTICLES. Quarterly Report, October 1, 1965–December 31, 1965. Haught, Alan F.; Polk, Donald H. (United Aircraft Corp., East Hartford, Conn. Research Labs.). Dec. 30, 1965. Contract AT(30-1)-3578. 15p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

The focused high-intensity beam from a Q-spoiled ruby laser was used to form a high-temperature, high-density plasma from a single 10 to 20 micron diameter solid particle of lithium hydride suspended in a vacuum environment free of all material supports. Experimental measurements were carried out to determine the isotropy of the plasma. Calculations were made of the expansion rate, temperature time history, and predicted average energy of these plasmas on the basis of a simple model of the plasma energy absorption and expansion process. (M.O.W.)

10149 (SRRC-RR-65-96) ELECTRON THERMAL DIFFUSIVITY IN RARE-GAS AFTERGLOW PLASMAS. Scientific Report No. 3. Nygaard, K. J. (Sperry Rand Research Center, Sudbury, Mass.). Nov. 1965. Contract AF19(628)-4183. 39p. (AFCRL-65-842). CFSTI $2.00 cy, $0.50 mn.

An experimental investigation of the electron thermal diffusivity D_T in room-temperature afterglow plasmas in neon and helium is described. The measurements were made in the absence of a magnetic field and covered an electron density range from 10^9–10^{12} cm^{-3}. The principle of the experiment was to heat the electrons selectively by a short microwave pulse, and then observe electron temperature transients at different locations within the plasma. The electron temperatures were determined by taking advantage of the temperature sensitivity of the electroacoustic Tonks–Dattner resonances. For electron-ion collision frequencies much larger than the electron-neutral collision frequency, the experimental data for D_T are inversely proportional to the electron density, and agree closely with the transport theory of Spitzer and Härm. In the limit of the weakly ionized plasma, the electron thermal diffusivity is independent of electron density, which is also in agreement with theory. The experimental method covers the transition region between the weakly- and the fully-ionized plasma limits without any assumptions about the relaxation time for energy exchange. The results were compared with others using the recombination light quenching method. The method of afterglow quenching is applicable only in the early stages of the afterglow when recombination is present, whereas the Tonks-Dattner resonance method is of particular value when the plasma density is lower and controlled by ambipolar diffusion. Agreement between the two methods was found for narrow ranges of density in which both are applicable. (auth)

10150 (TID-22429) RESEARCH ON INSTABILITIES IN HIGHLY IONIZED LOW-PRESSURE METAL-VAPOR PLASMAS. Final Report. Williams, E. M. (Carnegie Inst. of Tech., Pittsburgh, Pa.). Oct. 1, 1965. Contract AT(30-1)-3100. 54p. Dep. mn; CFSTI $3.00 cy, $0.50 mn. (NYO-3100-1).

Results from experimental studies of plasma phenomena in a positive column are presented. The column contains a sharp change in cross section and as a result of this a plasma sac (bounded by a double sheath) is formed. The plasma diagnostics were determined by various probe measurements. A discussion of the probe characteristics is presented. (M.O.W.)

10151 (TID-22429, App.A) A TENTATIVE IMPROVED MODEL FOR THE OSCILLATIONS IN THE PLASMA SAC. Kettani, Ali (Carnegie Inst. of Tech., Pittsburgh, Pa.). 41p.

Plasma oscillations in a positive column with sharply changing cross section were investigated. A theoretical model is derived for the oscillations at the sac (double sheath) of the plasma. (M.O.W.)

10152 (TID-22463) INSTABILITY OF A BOUNDED CYLINDRICAL PLASMA IN A UNIFORM AXIAL MAGNETIC FIELD. Plasma Physics Bulletin, Vol. 5, No. 3, October 1965. Robertson, Harry S.; Hawkins, Lawrence C. (Miami Univ., Coral Gables, Fla. Dept. of Physics). Contract AT(40-1)-2454. 27p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

The theory of the stability of a bounded cylindrical electrodeless plasma in an axial uniform magnetic field is developed for the regime in which the mobilities are independent of ion density. For r-f plasmas, the excitation frequency is very much higher than characteristic frequencies associated with the instability, so that only the low-frequency and d-c fields need be considered. The formulation leads to the physical picture of Hoh, in which opposite azimuthal drifts of ions and electrons create an azimuthal electric field that produces an outward $\vec{E} \times \vec{B}$ drift and a helical instability. Exact solution of the resulting equations was not possible. The dependence of theoretical results upon the nature of the approximate solutions is discussed. (auth)

10153 (SC-T-65-0773) KINETIC THEORY OF WEAKLY IONIZED HOMOGENEOUS PLASMA. PART II. Bayet, Michel; Delcroix, Jean-Loup; Denisse, Jean-Francois. Translated by Marcel I. Weinreich (Sandia Corp., Albuquerque, N. Mex.), from J. Phys. Radium, 16: 274-80(Apr. 1955). 19p. Dep. mn; JCL $1.60 fs, $0.80 mf.

The approximation of the second order of the distribution function was studied, i.e., the energy exchanges between the electric field and the plasma; one obtains then a term proportional to the time, in other words, divergent, which can be interpreted as a continuous heating of the electronic gas, so that a stationary state does not exist. In conclusion, one defines and calculates the quality factor "Q" of the plasma. (auth)

10154 UNCERTAINTIES IN THE MEASUREMENT OF HELIUM PLASMA TEMPERATURE BY THE RELATIVE INTENSITY METHOD. Chuang, H. (Harvard Univ., Cambridge, Mass.). Appl. Opt., 4: 1589-92(Dec. 1965).

Helium plasma temperature estimated by means of the two-line ratio method is shown to have a high degree of uncertainty. The Fowler-Milne method is proved to be more accurate and appropriate than the two-line ratio method for helium plasma temperature measurement in the temperature range up to about 25,000°K. (auth)

10155 A MULTIPLE-SCAN, RAPID-SCAN SPECTROGRAPH FOR ELECTRON DENSITY MEASUREMENTS IN TRANSIENT PLASMAS. Hill, R. A. (Sandia Lab., Albuquerque, N. Mex.). Appl. Opt., 4: 1593-5(Dec. 1965).

Our rapid-scan spectrograph was modified to provide a means of recording many time-resolved profiles of one emission line from a transient plasma. This is accomplished by scanning an emission line across an array of closely spaced exit slits. Post-optics were designed which direct the radiation from each slit to the same photomultiplier tube. At a spectral scan speed of 120 Å/μsec, an emission line profile was scanned every 1.4 μsec; however, with closer spaced slits, this time could be easily halved. This device was used to obtain Stark-broadened H_α and H_β line profiles from hydrogen heated in an impulse tube. Electron densities obtained by fitting the line wings of H_α compare very well with values obtained from the half-width of H_β. (auth)

10156 PLASMA RESONANCES AS A DIAGNOSTIC METHOD. Caldirola, P.; Agnello, V.; Finzi, U.; Fontanesi, M.; Sindoni, E. (Univ., Milan). Appl. Phys. Lett., 7: 300-2(Dec. 1, 1965).

An experiment was carried out in order to utilize plasma resonance phenomena as a diagnostic tool for electron density measurements. Measurements were performed for several values of the magnetic field and the r-f electric field producing the plasma. A typical diagram is given showing three series of resonances, related in a good agreement with those given by theoretical formulas. The disturbance produced in the plasma by the r-f probing signal made the study of resonances difficult. But the peaks produced by this perturbation cannot be confused with plasma resonances, for their positions are not affected by varying plasma parameters. (J.F.P.)

10157 PLASMA STABILITY IN A TRAP WITH STABILIZING POLES. Trubnikov, B. A. At. Energ. (USSR), 19: 415-20(Nov. 1965). (In Russian).

The known criterion for the stability of plasma $\delta\int dl/B < 0$ is generalized for the case of an anisotropic plasma ($p_{||} \neq p_{\perp}$) in axially nonsymmetric fields. Conditions of stability in a trap with stabilizing poles are found. Results of the calculation satisfactorily agree with experimental data obtained on the PR-5 device. (tr-auth)

10158 MAGNETIC TRAP WITH FIELD INCREASING ON ALL SIDES. Morozov, A. I.; Solov'ev, L. S. At. Energ. (USSR), 19: 420-3(Nov. 1965). (In Russian).

The nature of the stationary points in the curve of the square of the magnetic-field intensity for a trap in which the modulus of the intensity increases in all directions from the center is examined. The properties of the magnetic trap proposed by Andreoletti (Compt. Rend., 256, 1969 (1963)), which has an end-type radial magnetic field whose force lines extend beyond the trap region, are studied. (M.J.T.)

10159 POSSIBILITY OF SELF-SUSTAINING THERMONUCLEAR REACTIONS IN A MAGNETIC MIRROR MACHINE. Sivukhin, D. V. At. Energ. (USSR), 19: 510-17(Dec. 1965). (In Russian).

The energy balance in different variants of a thermonuclear reactor using a magnetic-mirror trap is studied. Only energy losses associated with the escape of particles through the magnetic mirrors are taken into account. It is very probable that it is impossible to obtain a self-sustaining thermonuclear reaction in a trap with magnetic mirrors. (tr-auth)

10160 REFLECTIONS OF ALFVEN WAVES FROM LOCALIZED INHOMOGENEITIES OF THE MAGNETIC FIELD. Skorupski, A. (Inst. for Nuclear Research, Polish Academy of Sciences). Bull. Acad. Pol. Sci., Ser. Sci. Math. Astron. Phys., 13: 425-31(1965).

Alfvén waves propagating in an external axially symmetric magnetic field of localized inhomogeneity are considered. For these waves an approximate formula for the reflection coefficient R was obtained. In special case of the inhomogeneity caused by a short coil the parameters F and S entering the approximate formula for R were effectively determined and the formula was numerically checked. It turned out sufficiently accurate in all cases where the reflection was noticeable. (auth)

10161 EXPERIMENTAL STUDY ON THE PLASMA GUN. Be, S.; Nakano, Yoshiei (Tokyo Inst. of Tech.). Denki Gakkai Zasshi, 85: 1432-8(Aug. 1965). (In Japanese).

Some preliminary results are reported on the current sheet shape, magnetic field, and current distribution in a coaxial plasma accelerator. These results may help to explain the mechanism of current sheets, as well as other mechanisms concerning the dynamic interaction of a plasma and magnetic field. Descriptions are given of the accelerator and magnetic probes. The velocity of the luminous front was determined by using a photomultiplier. Electron temperature was measured by the double probe. By determining the magnetic field distribution in a coaxial plasma accelerator and current distribution, the following parameters were obtained: (1) loop current between the current sheets, (2) axial electric field distribution and a radial electric field, (3) plasma conductivity, and (4) an internal efficiency of energy conversion in the current. By investigating collectively these plasma physical parameters, the shape of the plasmoid, its acceleration mechanism, and its magnetohydrodynamic behavior were elucidated. (TCO)

10162 COLLISION-FREE CURRENT CONVECTION AND ITS DYNAMIC STABILIZATION. Vladimirov, V. V. Dokl. Akad. Nauk SSSR, 162: 785-8(June 1, 1965). (In Russian).

Current convection can take place in a inhomogeneous low-pressure plasma under a constant longitudinal magnetic field, when the frequency of collisions of charged particles with neutral particles is smaller than the remaining characteristic frequencies of the system. The inertia of the ions play an important role in the mechanism of the current convection. In analyzing this instability the kinetic equation for the electrons and the hydrodynamic equations for the cold ions are linearized with respect to the perturbations. Thus, expressions are obtained for the perturbed electron and ion densities. The dispersion relation is derived from assuming a condition of quasineutrality. The perturbed electric field must be almost transverse. The frequency and increment of the instability coincide with the reciprocal of the time of flight of electrons in the discharge interval. An analysis taking into account the ion inertia shows that the imposition of a high-frequency current (with a frequency greater than the reciprocal of the electron flight time during the discharge) of sufficient amplitude on the main current can stabilize the short wavelength perturbations. (TTT)

10163 A PROBLEM WITH INITIAL DATA FOR THE KINETIC EQUATION IN A HOMOGENEOUSLY EXPANDING (CONTRACTING) PLASMA. Cheremisin, F. G. (Inst. of Mechanics, Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 163: 315-18(July 11, 1965). (In Russian).

A solution of a system of plasma kinetic equations having a Landau collision integral is presented analogous to the solution reducing Boltzmann's equation to the Cauchy problem in a homogeneous medium at rest. The system considered is $(\partial f^{\alpha}/\partial t) + v_{\alpha l}(\partial f^{\alpha}/\partial x_l) = -\Sigma_{\beta}(\partial/\partial v_{\alpha k}) j_k^{\alpha/\beta}$, where $j_k^{\alpha/\beta} = 2\pi\lambda(e^4/m_{\alpha})\int U_{lk}[(f^{\alpha}/m_{\beta})(\partial f^{\beta}/\partial v_{\beta k}) - (f^{\beta}/m_{\alpha})(\partial f^{\alpha}/\partial v_{\alpha k})] dv_{\beta}$; $U_{lk} = (\delta_{lk}/v) - (v_l v'_k/v^3)$, $v_l = v_{\alpha l} - v_{\beta l}$; $\lambda = \ln(D/\rho_0) = \ln[(T/8\pi ne^2)^{1/2}/(e^3/3T)]$. (ATD)

10164 THE MECHANISM RESPONSIBLE FOR SECONDARY RADIATION PEAKS DURING A PULSE DISCHARGE IN NEON. Vul'fson, K. S.; Libin, I. Sh.; Chernyak, A. Sh. (All-Union Scientific Research Inst. of Lighting Engineering, USSR). Dokl. Akad. Nauk SSSR, 163: 1113-14(Aug. 11, 1965). (In Russian).

Using a low-resistance discharger to bypass a neon gas discharge results in an additional emission pulse with an amplitude which may be twice the maximum emission of the discharge without bypassing. P. D. Johnson, T. H. Rautenberg, Jr., M. Harris (J. Appl. Phys., 35: No. 4, 1128(1964)) considered two possible mechanisms for this phenomenon: population inversion in excited levels; and disruption of recombination conditions due to a change in the behavior of the reduction in electron temperature of the discharge. The experimental examination of these hypotheses given by Johnson, et al. definitely refuted the first mechanism and did not give any evidence in favor of the second. It is proposed that the effect is due to eddy currents which arise in the discharge plasma when there is a sharp change in the discharge current. This hypothesis was experimentally checked by the oscillograph method. It was found that any sharp change in the discharge current, no matter what the causes of this change, is always accompanied by secondary peaks in the neon emission. The amplitude of these peaks is directly related to the rate of change in the discharge current, and in certain cases is 8–10 times greater than that of the fundamental radiation peak. An inductance connected in series with the neon tube or with the bypass discharger always reduced the amplitude of these peaks, or eliminated them entirely. Analysis of the distribution of illumination in the cross section of the discharge also confirms the new hypothesis on the mechanism responsible for this phenomenon. This effect could possibly be used for producing extremely intense light pulses with a steep front. (ATD)

10165 BEAM-PLASMA INTERACTION IN A WARM PLASMA. Crawford, F. W. (Stanford Univ., Calif.). Int. J. Electron., 19: 217-32(Sept. 1965).

Theoretical studies of electron beam–plasma interactions have predicted the occurrence of amplifying waves having growth rates maximizing near to the electron plasma frequency. For the special case of an infinite beam interacting with a cold infinite plasma, an infinite growth rate is expected at the plasma frequency. In practice, the theoretical gain becomes finite if factors such as collisions

or non-zero electron temperature are taken into account, or if the beam and plasma are not both infinite. The beam–plasma interaction is investigated in planar geometry for both finite and infinite beams in an infinite, uniform, warm plasma. In the finite beam case, the question of appropriate boundary conditions to use at the beam edge arises. For cold plasmas, the Hahn approximation involving postulation of an equivalent surface charge at the beam edge is usually applied. In the case of a warm plasma, it is unlikely that this approximation would describe accurately the plasma behavior, though it may still be appropriate for the beam. Suitable boundary conditions are suggested, and computed curves are presented comparing the complex solutions of the resulting dispersion relation with the cold plasma solutions for the same geometry. For typical experimental conditions a substantial reduction of gain is indicated when non-zero electron temperature is taken into account. (auth)

10166 ON SETTING UP A QUASI-ONE-DIMENSIONAL FLOW OF PLASMA IN A PROFILED CHANNEL. Brushlinskii, K. V.; Zueva, N. M.; Morozov, A. I. Izv. Akad. Nauk SSSR, Mekh., No. 5, 3-6(Sept.-Oct. 1965). (In Russian).

The problem of the establishment of stationary regimes of plasma flow in channels formed by two electrodes is considered. The flow was investigated in quasi-one-dimensional (hydraulic) approximation for plane channels of variable but slowly changing cross section. The problem was solved by means of numerical integration of the equations of magnetohydrodynamics. The process of the establishment of stationary regimes of plasma flow was investigated and the dependence of the flow parameters on the plasma conductivity and on the comparative size of the magnetic and gas dynamic pressures at the channel outlet was examined. (tr-auth)

10167 MAGNETOPLASMA WAVEGUIDE WITH VISCOSITY AND HEAT CONDUCTION. Sodek, B. A. Jr. (General Dynamics, Fort Worth, Tex.). J. Nucl. Energy: Pt. C, 7: 547-61(Nov./Dec. 1965).

A two-fluid analysis of the modes of propagation in a magnetoplasma-filled waveguide may be based upon the solution of a pair of coupled partial differential equations for the longitudinal components of the hydromagnetic wave. A method of solving these equations, which involves a system of transcendental equations for a set of undetermined parameters, is indicated. Approximate solutions are obtained with pressure, resistivity, viscosity, heat conduction, and current inertia treated exactly, while neglecting certain effects, such as the Hall effect, which are generally small at hydromagnetic frequencies. The effects of viscosity and heat conduction on the dispersion relations are shown explicitly. (auth)

10168 THEORY OF THE FLUTE INSTABILITY IN MIRROR MACHINES. Jungwirth, K.; Seidl, M. (Czechoslovak Academy of Sciences, Prague). J. Nucl. Energy: Pt. C, 7: 563-81(Nov./Dec. 1965).

The flute instability of a low β and neutral plasma contained in a mirror machine is investigated. The particle motion in a real mirror field is fully taken into account by using a Hamiltonian method for the solution of the Vlasov equation. An eigenvalue equation is obtained for the potential of the flute-like perturbation assuming an arbitrary radial dependence of plasma density and of the electron and ion energies. Using a variational method, the eigenvalue equation was discussed in detail for a plasma with no energy gradients. The stability condition was calculated taking into account terms up to second order in Larmor radius. Finite Larmor radius stabilization is effective for the higher-order modes and cold electron plasmas. The lowest mode, $k = 1$, is practically not stabilized by finite Larmor radius effects. The discussion of the eigenvalue equation with finite energy gradients is limited to the case of a hot electron plasma surrounded by a sheath of cold plasma. If the density of the cold plasma is an order of magnitude higher than the density of the hot plasma, the system is stable at all densities. The stabilization is due to the high dielectric constant of the cold plasma. (auth)

10169 PLASMAS WITH POLYNOMIAL DISPERSION FUNCTIONS. Linson, L. M. (Stanford Univ., Calif.). J. Nucl. Energy: Pt. C, 7: 583-4(Nov./Dec. 1965).

Plasmas are considered that lead to a polynomial dispersion relation rather than a transcendental one as does a Maxwellian plasma. A search is made for the totality of the class of velocity distribution functions that lead to a polynomial dispersion relation. (L.B.S.)

10170 A NEGATIVE V" SYSTEM BY USE OF A HELICAL TUBE. Amano, T. (Princeton Univ., N. J.). J. Nucl. Energy: Pt. C, 7: 589-91(Nov./Dec. 1965). (MATT-340).

A closed system for stable confinement of plasma is presented, which makes use of the curvature in a helix. (L.B.S.)

10171 THE DRIFT OF A PARTIALLY IONIZED PLASMA ACROSS A TOROIDAL MAGNETIC FIELD. Olson, O. D.; Skarsgard, H. M. (Univ. of Saskatchewan, Can.). J. Nucl. Energy: Pt. C, 7: 591-2(Nov./Dec. 1965).

A partially ionized plasma in a torus with non-conducting walls and confined by a time-independent magnetic field directed around the axis of the torus is considered. It is shown that as a consequence of collisions with neutral gas molecules the plasma acquires a quasi-stationary drift velocity across the toroidal field. (L.B.S.)

10172 COLLOQUE DE PHYSIQUE DES MILIEUX IONISES, TOULOUSE, 28 ET 29 MAI 1965. (Conference on Physics of Ionized Media, Toulouse, May 28–29, 1965). J. Phys. (Paris), 26: 441-536(Aug.-Sept. 1965). (In French). (CONF-650569).

The conference included 23 papers. Separate abstracts were prepared for 20 papers. The three papers not abstracted were "Negative Resistance Produced by the Ramsauer Effect in a Triode Filled with Xenon," in which the characteristic curves are given, "Thermionic Converters Using Photons as an Ionizing Source," in which experimental converters were heated by solar radiation, which was also used simultaneously for the ionization process, and "Anode Effects in Point to Plane Discharges," in which the mechanism of formation and the properties of the discharge are studied. (J.F.P.)

For abstracts of individual papers see: 9844–9847, and 10173–10188.

10173 DETERMINATION OF THERMODYNAMIC CHARACTERISTICS OF A HYDROGEN PLASMA. Fauchais, P. (Faculte des Sciences et E.N.S.M.A.; Poitiers, France). J. Phys. (Paris), 26: 441-4(Aug.-Sept. 1965). (In French).

The computation of the thermodynamic properties of a partially ionized hydrogen plasma at temperatures up to 25,000°K and pressures from 10^{-2} to 100 atm, assumed to be in equilibrium, requires the knowledge: of the number of significant terms n^* of the electron partition functions Z_{el} of the neutral and ionized particles, of the interaction energy between charged particles. The investigation of results, obtained by limiting Z_{el} with the help of five different theories and using an interaction potential of the "Debye" type, leads to the conclusion that at the temperatures and pressures considered it is now possible to evaluate the composition, the enthalpy and the entropy of the plasma in a simple way with less than 5% of relative uncertainty, using the rigid spherical model of atoms proposed by Gurvich and Kvlividze to compute n^*. (auth)

10174 BEHAVIOR OF A PLASMA CAPTURED DURING COLLISION IN A MAGNETIC MIRROR BOTTLE. Jacquinot, J.; Leloup, C.; Poffe, J. P.; Waelbroeck, F. (EURATOM-CEA, Fontenay-aux-Roses, France.). J. Phys. (Paris), 26: 445-6(Aug.-Sept. 1965). (In French).

In the magnetic mirror bottle of the "Bille-en-Tête A" experiment, the plasma is stable and the decrease of the confined energy is due to a temperature decrease. The cold plasma situated beyond the mirrors seems to be responsible for these two effects. (auth)

10175 OSCILLATIONS AND NON-MAXWELLIAN DISTRIBUTION OF ELECTRONS IN A CESIUM PLASMA. Moreau, J. B. (Conservatoire National des Arts et Metiers, Paris). J. Phys. (Paris), 26: 448-50(Aug.-Sept. 1965). (In French).

A cesium plasma with a Langmuir probe incorporated was developed. It is shown that there is an inversion of the sign of the sheaths at the collector or at the emitter depending on the diode working point position. When the sheath at the emitter is electronic, the electron distribution is Maxwellian. When the sheath is ionic, oscillations appear as well as two groups of electrons having different velocities. (auth)

10176 THE RESONANCE PROBE. Taillet, J. (CEN, Saclay, France). J. Phys. (Paris), 26: 457-63(Aug.-Sept. 1965). (In French).

If a h-f voltage is superimposed on the d-c bias of a Langmuir probe, a collective oscillation can be excited in the plasma, from which the electron density can be deduced. After a short review of the published results in connection with this behavior, a simplified model is presented to explain the physical mechanism of the resonance probe. (auth)

10177 DIRECT MEASUREMENT OF EJECTION VELOCITIES IN A PLASMA PROPULSOR. Metge, Emile. J. Phys. (Paris), 26: 463-5(Aug.-Sept. 1965). (In French).

Using the Döppler shift on some spectral lines, it is possible to determine the velocity distribution in a plasma jet assumed to be in a local thermodynamic equilibrium. An apparatus, including particularly a Fabry-Perot interferometer, is described. Macroscopic velocities, from 7 km/s to 11 km/s, were measured with an accuracy of about 10%. (auth)

10178 USE OF LANGMUIR PROBES IN DENSE PLASMA JETS. Cabannes, F.; Joubert, F. (CNRS, Bellevue, France). J. Phys. (Paris), 26: 466-8(Aug.-Sept. 1965). (In French).

In order to determine the temperature in the jet of a plasma torch, with an accuracy of 10%, a simple method is described. One can obtain a plasma jet with the same potential as the front electrode, and by measurement of the insulated probe potential the temperature of the jet can be calculated from the theory of the Langmuir probe. The agreement with spectroscopic measurements is good. (auth)

10179 SPECTROGRAPHIC MEASUREMENT OF THE TEMPERATURE OF A PLASMA JET BY THE STARK EFFECT. Berty, Michel (Univ., Paris). J. Phys. (Paris), 26: 469-71(Aug.-Sept. 1965). (In French).

The temperature of a hydrogen plasma jet at atmospheric pressure is determined by the measurement of the electric field on the profile of a Stark broadened line, by comparison between Griem's theory and experimental data. The apparatus used and the results of measurements on a hydrogen plasma at 10 kw are described. The temperatures obtained range from 15,000 to 11,000° in the plasma jet, radially and axially. (auth)

10180 VARIOUS EXTENSIONS OF OHM'S LAW IN GASES. Dolique, J.-M. (Univ. Paris, Grenoble, France). J. Phys. (Paris), 26: 473-6(Aug.-Sept. 1965). (In French).

Starting from the rigorous equations of motion, for partial fluids, electronic, ionic, and neutral and for the gas as a whole, one establishes an Ohm's law, in the partially ionized gases, more rigorous and general than the law given by Cowling. This law is then extended to more general media: partially ionized plasmas where, by inelastic collisions, particles appear or disappear in volume, and non-neutral partially ionized gases. (auth)

10181 PLASMAS PRODUCED BY A LASER. Nelson, P. (CEA, Paris). J. Phys. (Paris), 26: 476-82 (Aug.-Sept. 1965). (In French).

A careful metrology of the experiment of production of a plasma by a laser gives good quantitative results which lead to a theoretical interpretation. The beam of a pulsed laser, focused on a metallic target, makes a crater and produces an intense emission of ions, electrons, and x rays of a few kev. These phenomena are produced by the absorption of light by skin effect. The beam of a pulsed laser focused in a gas produces the formation of a ball of ionized gas, which is very opaque. Ionization and absorption are due to multiphoton ionizations. The hydrodynamics of the ball is studied. (auth)

10182 STRUCTURE OF SHOCK WAVES IN A PARTIALLY IONIZED GAS. Jaffrin, M. J. Phys. (Paris), 26: 483-5(Aug.-Sept. 1965). (In French).

The structure of a steady plane shock in a partially ionized gas is investigated using a three-fluid Navier-Stokes model. With the assumptions of quasi-neutrality and frozen ionization, the velocities, temperatures, electric field, and potential distributions through the shock are obtained by numerical integration for different values of the degree of ionization and Mach number. (auth)

10183 INTERACTION OF TRAVELLING MAGNETIC FIELDS WITH IONIZED GASES. Rocard, J. M. (Litton Systems Inc., Beverly Hills, Calif.). J. Phys. (Paris), 26: 497-504(Aug.-Sept. 1965). (In French).

Lorentz forces are usually the accelerating forces used in plasma accelerators. As far as traveling wave accelerators are concerned, it is very important to check that this Lorentz force has always the same direction and that the magnetic induction is still important in spite of plasma loading. A few properties of traveling fields due to a linear coil system fed by polyphased currents are briefly described. In particular, the end effects, which appear as "bumps" in the profile of the magnetic induction along the accelerator axis, may cause a deceleration of the ionized gas jet. This situation can be avoided by a judicious configuration of the coil system. The interactions of the ionized gas with the field producing currents can introduce some instabilities which, in turn, react on the traveling field itself. Those effects are avoided when the polyphased networks are tuned in a completely symmetric manner. (auth)

10184 PROPAGATION AND COUPLING OF WAVES IN A TURBULENT PLASMA. Frisch, U. (Institut d'Astrophysique, Paris). J. Phys. (Paris), 26: 507-10 (Aug.-Sept. 1965). (In French).

The propagation of waves in a random medium (plasma) is studied with special reference to energy transfer between wave modes. (auth)

10185 ACOUSTIC WAVES AND SPURIOUS SOUNDS IN A PARTIALLY IONIZED GAS. Durand-Viel, X. (Ecole Polytechnique, Paris). J. Phys. (Paris), 26: 511-13(Aug.-Sept. 1965). (In French).

Within a macroscopic theory, all collisions and the viscosity of the neutral particles being taken into account, the dispersion relation for plane longitudinal waves is established. Two modes subsist in a low frequency approximation: an acoustical mode and an ionic one. Different approximations, which are determined by means of the ratio of the neutral and charged particle energies, allow the phase velocity and damping of both modes to be explained. (auth)

10186 IONIC ELECTROSTATIC INSTABILITY IN A CESIUM DISCHARGE. Doucet, H. (Ecole Polytechnique, Paris). J. Phys. (Paris), 26: 514-16(Aug.-Sept. 1965). (In French).

The stability of cesium "Q" type machines is analyzed for hot plasma-beam interactions in a very low frequency range in the sheath and in the plasma. A simple sheath theory allows calculation of plasma potential and of current variations as functions of the applied voltage between the emitters. It can be seen that in a general way, a cesium machine working in a vapor pressure mode can be stable, but with direct injection an instability appears above a critical density value when a voltage is applied between the emitters. Apparently, such an instability is observed in a Cs filled sealed bulb, stable with respect to the sheath and the resistivity, and is attributed to asymmetrics of the emitters. (auth)

10187 PHYSICAL MECHANISM OF HIGH-FREQUENCY DISCHARGES SUSTAINED BY RESONANCE. Taillet, J.; Brunet, A. (CEN, Saclay, France). J. Phys. (Paris), 26: 520-1(Aug.-Sept. 1965). (In French).

When a r-f discharge is excited with a frequency $\omega/2\pi$ higher than the collision frequency ν, a resonance due to the dispersive properties of the plasma can control the steady state of the discharge and determine the value of the electron density for a given geometry and frequency. (auth)

10188 DETERMINATION OF THE DOMAIN OF EXISTENCE OF PLASMOIDS IN HIGH-FREQUENCY ELECTRIC DISCHARGES WITH CAPACITIVE EXCITATION BETWEEN ELECTRODES. Bacri, J.; Benoit-Cattin, P.; Blanc, D.; Dagnac, R.; Ferre, J. (Faculte des Sciences, Toulouse). J. Phys. (Paris), 26: 522-4(Aug.-Sept. 1965). (In French).

The range of pressures where stable plasmoids exist was determined, the discharge being maintained by a 50 Mc field applied between two plane and parallel external electrodes. This range is limited by a closed curve. Measurements were made in helium, neon, argon, and xenon. This closed range does not depend upon the nature of the rare gas. (auth)

10189 HEATING OF IONS BY NONLINEAR ABSORPTION BY TRANSVERSE WAVES IN A PLASMA. Kovrizhnykh, L. (Lebedev Physics Inst., Academy of Sciences, USSR). JETP Lett. (USSR) (Engl. Transl.), 2: 89-91 (Aug. 1, 1965).

Attention is called to a possibility of direct heating of ions by nonlinear absorption of transverse waves by the plasma ions. The examination is confined to two particular cases which are sufficiently simple from a mathematical point of view and are of practical interest. It is assumed for the first case that two beams of transverse waves with identical spectral distribution propagate in a plasma head on, and a second case is considered in which the radiation intensity does not depend on the angles. It is found that the mechanism of nonlinear absorption considered can serve as one method for directly heating plasma ions. It is emphasized that the efficiency of this method depends essentially on the ratio of electron and ion temperatures, and decreases sharply for a non-isothermal plasma with the electron temperature much greater than the ion temperature. (J.F.P.)

10190 INVESTIGATION OF THE STRUCTURE OF THE FRONT OF A STRONG MAGNETIC-SOUND WAVE IN A RAREFIED PLASMA. Zagorodnikov, S. P.; Rudakov, L. I.; Smolkin, G. E.; Sholin, G. V. JETP Lett. (USSR) (Engl. Transl.), 2: 151-4(Sept. 1, 1965).

An experimental investigation is made of the structure of the front of a strong magnetoacoustic wave propagating in a rarefied plasma transverse to a magnetic field. The results showed nonlinear twisting of the wave front in the plasma for values of the magnetic Mach number in the range from about 1.3 to 4.2. The profile of the magnetic field in the plasma was in good agreement with the profile calculated previously within the accuracy of the cylindrical effect. In the region where the magnetic Mach number varied between 2 and 4.2 no anomalous increase of the front width, corresponding to a collapse of the wave, was observed. This is apparently connected with the unsteady character of the wave. It was noted that the absorption of the wave energy on the front increased with increasing plasma density and at the same time electrons with energy greater than 50 ev appeared behind the wave front. (J.F.P.)

10191 INSTABILITY OF AN INHOMOGENEOUS PLASMA. Vlasov, M. A. JETP Lett. (USSR) (Engl. Transl.), 2: 174-7(Sept. 15, 1965).

An inhomogeneous plasma produced in a low-pressure arc discharge with incandescent cathodes was investigated. The main experimental results obtained at higher pressures [4 $(10)^{-4}$–$(10)^{-2}$ torr] are briefly described. The investigation of the plasma showed that there are two characteristic regions. In the first there are no plasma oscillations and the diffusion has a classical character. In the second, oscillations are observed with a spectrum that depends on the plasma parameters, and the diffusion has both classical and anomalous behavior features. The conditions for the occurrence of the plasma instability, and the character of the instability, depend strongly on the initial transverse gradients of density, potential, and temperature. An increase of the magnetic field leads to a sharp change in the character of the transverse diffusion. Torches break away from the primary column, and their structure was observed. It is noted that when this instability occurs the ion-acoustic oscillations do not disappear, and the number of produced torches always coincides with the number of the mode for the ion sound near the instability limit. (J.F.P.)

10192 INSTABILITY OF THE UNIFORM PLASMA TURBULENCE. Gailitis, A. (Inst. of Physics, Academy of Sciences, Latvian SSR). Latv. PSR Zinat. Akad. Vestis, Fiz. Tek. Zinat. Ser., No. 4, 13-17(1965). (In Russian).

It is shown that with increasing the plasma wavelength the sufficiently high plasma turbulence becomes unstable. Separate turbulence regions with decreased plasma density are formed there. (auth)

10193 LABORATORY OBSERVATIONS OF PLASMA INSTABILITIES IN A DIPOLE MAGNETIC FIELD. Quinn, Robert G. (Catholic Univ. of America, Washington, D. C.). Nature, 208: 376-8(Oct. 23, 1965).

Laboratory investigations were made of plasma configurations in the field of a large magnetized sphere. Visible observations were made, which show that a stable configuration first becomes unstable, then returns to its former configuration. The results indicate that the laboratory model is a particular case of instability arising from the action of a constant transverse electric field. Additional evidence is also found in the measurement of the temporal dependence of the instability using a Langmuir probe. (L.B.S.)

10194 DEPENDENCE OF THE PROPERTIES OF MOVING STRIATIONS IN THE PLASMA OF THE POSITIVE COLUMN ON SOME EXTERNAL AND INTERNAL PARAMETERS. Lakatos, G.; Bito, J. (Industrial Research Inst. for Telecommunication Technique, Budapest). Nature, 208: 445-50(Oct. 30, 1965).

An investigation was made of the characteristic properties of higher-speed space-charge waves in plasma at a variety of discharge currents. Also a study was made of the influence of certain external and internal parameters on the moving striations of the d-c mercury vapor discharge using a Penning gas, and the dependence of the striations on these parameters was explained. Various parameters of moving striations are shown as functions of the value of the applied external resistance for an arc current of 100 mamp. The current dependence of frequency of the moving striation for various supply voltages, the amplitude of the variation of light intensity as a function of the discharge current for these voltages, the amplitude of the current variation as a function of the discharge current, stabilization for various supply voltages, and the temperature dependence of the frequency of the moving striation for specific discharge current values are shown. It is concluded that the external parameters, especially temperature, and the members of the external electric circuit have a critical influence on the striation process. (J.F.P.)

10195 A WAVE MECHANICAL APPROACH TO THE PLASMA INTERACTION PROBLEMS. Liu, V. C. (Univ. of Michigan, Ann Arbor). Nature, 208: 883-4(Nov. 27, 1965).

An alternative approach to the plasma interaction problem is presented. This leads to a more rigorous treatment of the charge-field coupling effect, thus shedding more light on the physical process of interaction. In this approach the motion of the particles is represented by the Schroedinger wave equation instead of the Boltzmann equation as used in the conventional approach. The stationary state is considered, and the absence of a magnetic field

is assumed, although the formulation can be generalized to include the magnetic field effect. A rarefied plasma flowing toward a fixed conductive body at hypersonic speed such that the free stream velocity is much larger than the thermal velocity of the ions and much smaller than that of the electrons is considered. The use of this method is illustrated by a plasma interaction problem for which an exact solution for the potential field can be obtained. (J.F.P.)

10196 SPECTROSCOPIC STUDY OF THE INTERACTION BETWEEN CHARGED PARTICLE BEAMS AND PLASMA. **Lifshits, E. V.** Opt. Spectros. (USSR)(Engl. Transl.), 19: 8-11(July 1965).

Translated from Opt. Spektros., 19: 19-25(July 1965).

The spectroscopic method of studying the interaction between charged particle beams and plasma in both the linear stage of this interaction and in the stage of saturation is examined theoretically. It is shown that spectroscopic study affords a means of determining the basic parameters of this interaction and of investigating their time dependence. (auth)

10197 EFFECT OF RADIATION ON THE STATE OF THE GAS DURING PASSAGE OF A SHOCK WAVE IN HYDROGEN. **Yakubov, I. T.** Opt. Spectros. (USSR)(Engl. Transl.), 19: 12-14(July 1965).

Translated from Opt. Spektros., 19: 26-9(July 1965).

An evaluation is presented of the photoionization of the gas before the front by radiation of the plasma which is heated by the shock wave (forward-flowing radiation). Radiational cooling of the gas behind the front is examined. It is shown that the recently published results of Whitney and Skalafuris contain substantial errors. (auth)

10198 ELECTRON TEMPERATURE MEASUREMENTS IN A MEGAJOULE THETA-PINCH BY LIGHT SCATTERING. **Kunze, H.-J.; Fuenfer, E.; Roehr, H.** (Institut fuer Plasmaphysik, Garching, Ger.). Phys. Lett., 19: 11-12 (Sept. 15, 1965).

A Q-switched ruby laser operating at an output between 100 and 200 Mw with a pulse length of about 40 nsec was used to measure the electron temperature in a Mjoule theta pinch. A monochromator equipped with a multiple exit slit of glass fibers was used. (G.O.Y.)

10199 DETERMINATION OF CHARACTERISTICS OF A CESIUM DISCHARGE BY A SHEATH THEORY. **Doucet, H.** (Ecole Polytechnique, Paris). Phys. Lett., 19: 12-13(Sept. 15, 1965). (In French).

The characteristics of a cesium discharge in a magnetic field were calculated by a sheath theory; the results were verified experimentally. (G.O.Y.)

10200 ON THE THEORY OF PULSE STIMULATED RADIATION FROM A PLASMA. **Kegel, W. H.; Gould, R. W.** (California Inst. of Tech., Pasadena). Phys. Lett., 19: 531-3(Dec. 15, 1965).

It is shown that the relativistic mass effect in a cold plasma in an inhomogeneous magnetic field gives rise to an echolike phenomenon with all the characteristics of the observed echoes reported previously. A plasma in a slightly inhomogeneous magnetic field excited by two short pulses at the electron gyrofrequency and having a certain time separation is treated. The radiation after the second pulse is considered. The problem is treated in the single particle approach. (J.F.P.)

10201 AFTERGLOW STUDIES IN HELIUM. **Gerber, R. A.; Sauter, G. F.; Oskam, H. J.** (Univ. of Minnesota, Minneapolis). Phys. Lett., 19: 656-8(Jan. 1, 1966).

Simultaneous measurements of the time dependence of the intensities of spectral lines and bands and of the number density of atomic and molecular helium ions in a decaying plasma are reported, and a preliminary interpretation is given. (auth)

10202 COLLECTIVE SCATTERING OF LASER LIGHT BY A PLASMA. **Chan, P. W.; Nodwell, R. A.** (Univ. of British Columbia, Vancouver). Phys. Rev. Lett., 16: 122-4(Jan. 24, 1966).

A vertically mounted argon plasma jet drawing 280 amp at 15 v from its power supply was used to scatter the light from a giant-pulse ruby laser with a peak power of 10 Mw and a pulse duration of 50 nsec. The scattered light observed at 45° in a forward direction showed strong collective effects of the ions and the electrons in the form of distinct satellite peaks on both sides of the central frequency. (G.O.Y.)

10203 A NEW METHOD OF MEASURING ELECTRON TEMPERATURES IN PLASMAS IN THE ABSENCE OF LOCAL THERMODYNAMIC EQUILIBRIUM. **Burgess, D. D.; Cooper, J.** (Imperial Coll. of Science and Tech., London). Proc. Phys. Soc. (London), 86: 1333-41(Dec. 1965).

A new method of measuring electron temperatures in plasmas is described which uses a property of the pressure broadening by electron impacts of isolated spectral lines, namely the temperature dependence of the shift-to-width ratio. The only requirement is that the electron velocity distribution can be described by a temperature, and no knowledge is required of bound level populations, or of the ionization equilibrium. The observations are made on line radiation, and no intensity calibrations are needed. The physical basis of the technique and validity criteria for its use are given. Limitations of theoretical estimates of line shifts are described. The so-called "plasma polarization" shift is discussed. Experimental results are given which demonstrate the possibilities of making such measurements, and which provide some evidence about the plasma polarization shift. (auth)

10204 NON-LINEAR GENERATION OF THIRD HARMONIC IN A MAGNETOPLASMA. **Sodha, Mahendra Singh; Kaw, Predhiman Krishan** (Indian Inst. of Tech., Delhi). Progr. Theoret. Phys. (Kyoto), 34: 557-73(Oct. 1965).

An expression was obtained for the third harmonic component of the current density in a magnetoplasma, when the electric field is at right angles to the direction of the magnetic field, by setting up and solving Boltzmann's transfer equation for electrons; in the expansion of the distribution function of electron velocities, the coefficient of v_x^2 was also taken into account. This expression was substituted in the appropriate wave equation and the solutions were used to study the generation of third harmonic of an electromagnetic wave in a magnetoplasma and on reflection from a magnetoplasma free-space interface, when the direction of propagation of the wave is along the magnetic field. Some numerical results depicting the phenomenon of resonance are given. An interesting result is that, when a pure mode of the fundamental propagates in a magnetoplasma, only the other mode of the third harmonic will be generated. (auth)

10205 MAGNETIC FIELD MEASUREMENT IN AN ELECTROMAGNETIC SHOCK TUBE USING LARGE AREA PROBES. **Miller, Bennett** (Columbia Univ., New York). Rev. Sci. Instrum., 37: 7-11(Jan. 1966).

The problem of measuring with a probe the magnetic field in a plasma which is moving with respect to the probe is examined. It is shown that integration with respect to time is, in general, not proper and correct expressions are developed for the case of a current conducting plasma produced by a strong ionizing shock wave in an electromagnetically driven shock tube. Use of the correct expressions is described for large area magnetic field probes employed in a coaxial electromagnetic shock tube. The results demonstrate the need for careful interpretation of data obtained from magnetic field probes used to measure magnetic fields in moving media. (auth)

10206 NULL METHOD OF MEASURING MICROWAVE PHASE SHIFTS. **Gardner, Andrew L.** (Univ. of California, Livermore). Rev. Sci. Instrum., 37: 23-8(Jan. 1966).

A companion paper by Gardner and Hawke described a microwave phase shifter, with constant output, capable of rapid phase control by the bias voltage applied to varactor diodes. The application of this device to measure phase shifts in a cw microwave system by a null method is described. If phase and amplitude variations are not too fast, standard oscilloscope components can provide most of the required circuitry. Examples are given, including the mea-

surement of 0.003° phase shift at 9 Gc in a plasma experiment. (auth)

10207 PROPAGATION OF SLOW WAVE IN AN INHOMOGENEOUS CYLINDRICAL PLASMA. Kikuchi, Makoto; Kihara, Masahiko (Tohoku Univ., Tokyo). Tohoku Daigaku Dentsu Danwakai Kiroku, 32: 192-5(Sept. 1963). (In Japanese).

Results of an analytical investigation of slow wave propagation in a cylindrical plasma are described. The plasma is inserted in an infinite d-c magnetic field whose direction is coincident with the axis of the plasma. Its electron density is not uniform, but distributes only in its radial direction. For simplifying the analysis, it is assumed that the radial distribution could be expressed in the equation $\rho(r) = \rho_0[1 - (r/r_0)^2]$. An analysis was carried out to obtain the dispersion characteristics and distribution of the r-f axial electric field. These results were compared with those for a uniform plasma. In this plasma condition, a slow wave has a larger phase constant than in the uniform plasma. And the axial electric field in the vicinity of the axis is more intensified than in the latter. (auth)

10208 THE STARK BROADENING OF BALMER LINES IN A HYDROGEN PLASMA PRODUCED BY INDUCED MAGNETIC FIELD. Hong, Ming-yuan; Yeh, Mow-foh; Sun, Hsiang (Academia Sinica, Peking). Wu Li Hsueh Pao, 21: 1606-18(Sept. 1965). (In Chinese).

The Stark broadening of Balmer lines in a hydrogen plasma produced by induced magnetic field was investigated. A condenser bank discharging into the coil surrounding the discharge tube, produces an alternating axial magnetic field which ionizes, compresses, and heats the hydrogen in the tube. The working conditions are: initial pressure of hydrogen, 2.0×10^{-1} mm Hg; charging voltage, 20 kv; discharge period, 14 microseconds; maximum current, 165 kamp. Profiles of the spectral lines of H_β and H_γ are studied by the photographic method. These lines are considerably broadened. In the whole luminous stage, the mean half-widths of H_β and H_γ are 14–16 and 18–19 Å respectively, corresponding to an ion density of $1.7–2.5 \times 10^{16}$ cm^{-3}. The experimental profiles agree better with Griem, Kolb, and Shen's theory than with Holtsmark's theory. Photoelectrical measurements show that the profile of H_β changes with time, accordingly the ion density changes also. At the primary current maximum of the third half-period of discharge, the ion density reaches a peak value of 3.2×10^{16} cm^{-3} which is 2.2 times the initial density of hydrogen atoms. (auth)

10209 THE DETERMINATION OF THE EMISSION COEFFICIENTS FROM THE INTENSITY PROFILE WITH AN ANALOG COMPUTER. Braun, Wolfgang (Plasma Physics Research Lab., Wright Patterson AFB, Ohio). Z. Angew. Phys., 19: 542-4(1965). (In German).

A method is given for the solution of the Abel integral equation which occurs in the determination of the emission coefficient of a radiating inhomogeneous layer. An analog computer was used for the evaluation; it was equipped with a function generator. The method is especially advantageous in application when the intensity profile is available as a diagram. It is shown how the mean error that occurs in the plotting of the intensity profile with a significant inlet aperture can be determined. (tr-auth)

10210 THE CONTINUOUS RADIATION OF THERMAL CARBON PLASMAS. Henning, Hinrich (Univ., Kiel). Z. Astrophys., 62: 109-20(1965). (In German).

The temperature of the C II lines in a pure thermal carbon plasma was determined using the Saha equation for the plasma system. The quantitatively measured continuum was attributed to the departure of ff and fg continuum from the C^- ion. The f-values as well as broadening and shifting of the C I lines are also reported. (tr-auth)

10211 THE ATTENUATION OF SPACE CHARGE WAVES IN A CYLINDRICAL PLASMA COLUMN [Thesis]. Tweedie, Thomas Charles Jr. Philadelphia, Temple Univ., 1965. 75p.

The attenuation of space charge waves in the cylindrical plasma column of a mercury discharge tube was studied by analyzing standing wave patterns. A uhf signal initiated the space charge waves in the operating discharge. From the ratio of successive amplitudes of the standing wave pattern traces the attenuation of the wave is calculated. It is found that two attenuation constants for the waves are present simultaneously. Measurements were made for discharge currents from 100 to 300 mamp and at signal frequencies from 250 to 1200 Mc. The data from all the wave patterns are presented in plots of the attenuation constants vs frequency at constant discharge current. The attenuation is constant at low frequency, increasing as the signal frequency approaches a cutoff frequency. The values of the attenuation constants at low frequencies are approximately $\alpha_1 = 0.025\text{cm}^{-1}$ and $\alpha_2 = 0.095\text{cm}^{-1}$ for 200 mamp. A model to explain the two attenuation constants is developed in terms of the collision cross section for electrons with mercury atoms. The cross section is velocity-dependent with a sharp peak at 1 ev. This behavior suggests that the cross section provides a velocity selector for electrons, separating them into two streams each with a distinct average velocity, particle density, and collision frequency. Thus there can be an attenuation constant associated with each stream. Measurements of the discharge current as a function of a transverse magnetic field appear to substantiate the double-stream interpretation. A theoretical derivation of the velocity distribution of electrons in a d-c mercury arc discharge is presented, which substantiates our two-stream model. In addition, the two-stream model was used to resolve apparent inconsistencies in experimentally determined dispersion curves. (Dissertation Abstr.)

10212 GUIDING CENTER MOTION OF PARTICLES IN COMBINED MIRROR-MULTIPOLE CUSP MAGNETIC FIELDS [Thesis]. Siambis, John George. Berkeley, Calif., Univ. of California, 1965. 126p.

The confinement of charged particles in combined mirror-multipole cusp magnetic fields was investigated by two methods: the adiabatic motion in terms of the magnetic moment (μ) and longitudinal invariant (J) of the particle; and the guiding center motion. The knowledge of the adiabatic motion provides information regarding containment, equilibrium and stability of plasma from the microscopic point of view. The guiding center motion provides a physical picture for the types of drift motion that exist in these combined fields and tests explicitly for the constancy of the longitudinal invariant J. Knowledge of the constancy of J defines the limit and range of applicability of various microscopic and macroscopic theories for the equilibrium and stability of plasma. For the mirror-quadrupole field there exist two types of magnetic geometries. The first has nearly straight field lines with stable average curvature over the region of confinement. The second has sharply curved field lines with stable curvature. For both these cases there exists one type of surface of adiabatic motion (surface of constant μ, J, and energy). For the mirror-hexapole field there exist three distinct types of surfaces of adiabatic motion. For the mirror-quadrupole field with nearly straight field lines and the mirror-hexapole field with the minimum B located "far" from the axis, the longitudinal invariant is conserved for values of the adiabatic parameter (λ) up to the order of $\lambda \sim 0.2$. For the mirror-quadrupole field with sharply curved field lines and the mirror-hexapole field with the minimum B "near" the axis, the longitudinal invariant in order to be conserved requires a smaller value of the adiabatic parameter (λ), $\lambda \sim 0.02$. The presence of shear and/or torsion in the field lines of the combined fields results in an oscillation of the guiding center about the surface of adiabatic motion. The amplitude of this oscillation at a given point on a surface of adiabatic motion increases linearly with the cyclotron radius of the particle. (Dissertation Abstr.)

10213 INVESTIGATION OF PLASMA OSCILLATIONS STIMULATED BY A PRE-BUNCHED ELECTRON BEAM FROM THE R.P.I. ACCELERATOR [Thesis]. Mendell, Jay Stanley. Troy, N. Y., Rensselaer Polytechnic Inst., 1964. 156p.

An experiment is described in which the electron beam from the R.P.I. Linear Accelerator was passed through an

argon plasma to discover whether microwave oscillations could be detected outside the discharge vessel. Because of resonance between the plasma frequency near the axis of the vessel and the sixteenth harmonic of the beam's fundamental frequency, the energy stored in the beam-plasma interaction region is expected to be high relative to the free-space value. Some of this energy is expected to escape from the vessel in the form of microwave radiation. A special microwave bridge and receiver were constructed for the study of the radiation. According to an harmonic analysis of the Linac beam current, based upon an examination of the energy spectrum of the Linac, a peak beam current of 0.3 amp contains a sixteenth harmonic component of about 0.1 amp amplitude. This current did not stimulate oscillations that could be detected with a K-band receiver placed outside the vessel. Taking into account the vessel-antenna geometry and the receiver sensitivity, it is concluded that the beam caused radiation at a level lower than 0.4×10^{-10} watts per centimeter of plasma traversed. (Dissertation Abstr.)

10214 ON KINETIC THEORY OF FULLY IONIZED GASES [Thesis]. **Hosack, Grant Austin. Lafayette, Ind., Purdue Univ., 1965. 171p.**

The Chapman-Enskog method is applied to the Boltzmann equation, which includes a macroscopic "Lorentz" force of the same order of magnitude as the short-range collision term, and a complete set of plasma equations including transport relations is derived (in the absence of any externally applied magnetic fields). The transport equations are shown to include transport phenomena arising from self-consistent electromagnetic effects. These phenomena can be significant for cases in which the self-consistent fields are large because of macroscopic non-uniformity or because of departure of the system from the equilibrium state. The collision integrals needed for the determination of the transport coefficients are computed. The variation method of Hirshfelder is then used to obtain these coefficients. (Dissertation Abstr.)

10215 A VARIATIONAL APPROACH FOR PLASMA CORRELATIONS [Thesis]. **Porter, James Colegrove. Lafayette, Ind., Purdue Univ., 1965. 130p.**

A derivation by a variational method of plasma kinetic equations that take into account effects due to Coulomb correlations is presented. Both classical and quantum plasmas are considered. In each case the specific system of interest is an electron gas moving in a static, uniform background of compensating positive charge. No external electromagnetic fields are assumed to act and magnetic-magnetic interactions and boundary effects are not considered; also the ratio of the average inter-electron spacing to the Debye shielding distance is taken to be small. The kinetic equations obtained are intended to replace the exact descriptions in the classical Liouville equation and Schroedinger equations respectively by optimal approximations in the sense of the variational principle used. The effects of Coulomb correlations are included in the approximate way by introducing, into the classical and quantum trial functions, certain auxiliary functions that depend on the positions and velocities of two electrons jointly. The classical kinetic equations reproduce the first two members of the B.B.G.K.Y. hierarchy. Furthermore, the approximation implicit in the use of a trial function which includes functions of at most two variables is seen to lead to the reduction of the hierarchy to a pair of closed, coupled relations from which corrections to the Boltzmann-Vlasov equation can be determined. The present classical kinetic equations should be of use in situations where a variational approach is particularly appropriate because of the availability of information about the form of the expected corrections. The analogous quantum kinetic equations provide a much simpler way of obtaining corrections to the Hartree-Fock equations than any previous, equally general variational approach. These equations can be applied in a wide range of physical situations and specific solutions are obtained for the case of a degenerate electron gas. (Dissertation Abstr.)

10216 DENSITY MODULATIONS IN RADIO FREQUENCY PLASMAS. **Schlueter, H.; Durham, J.; Ransom, C. J. (Univ. of Texas, Austin). 4p. (CONF-650220-4). ORINS. Gmelin, AED-CONF-65-022-8.**

From American Physical Society, Southwest Meeting, Norman, Okla.

It is reported that observed striation-like structures of hydrogen r-f discharge conform with the frame suggested by Pekarek and Krejci (Czech. J. Phys., B12: 722 (1962)). There is a smooth transition between rotating and stationary helical structures, and no distinguishing features were found in various observations. The profiles of lower Balmer lines of H_4 to H_6 are predominantly Doppler broadened. The profiles of the brighter and darker regions are virtually identical. At about H_7 the decrease of the half-width with wave length stops, and with further increasing of upper principal quantum number of the transition the profiles become broader. Moreover, now the profiles of the darker regions become broader than those of the brighter regions. The intensities of the darker regions are lowered by about a factor of 2. These observations are considered. (J.F.P.)

10217 METHOD AND APPARATUS FOR PRODUCING CONTROLLED NUCLEAR FUSION. **Nowak, Karl. British Patent 1,012,751. Dec. 8, 1965. Priority date June 21, 1961, Austria.**

An apparatus and method are described for producing controlled nuclear fusion by bringing together accelerated atomic ions in a vacuum chamber and using an electronic beam to form a plasma of the ions. The beams intended for fusion are directed in opposite directions axially of one another while being magnetically constrained to take spiral or helical paths. An electron current is fed intermittently to the zone of collision of the beams in order to form the localized plasma to maintain the radial axial speed of the ions and to produce the fusion between the ion beams. (B.L.M.)

10218 DEVICE FOR GENERATING A HIGH-TEMPERATURE PLASMA SHOWING SMALL LEAKAGE LOSSES. **Lehnert, Bo Peter; Bonnevier, Bjoern Karl Johan. German Patent 1,203,398. Oct. 21, 1965. Priority date June 12, 1959, Sweden.**

The device consists of two toroidal, tubular electrodes, one of which encloses the other. The inner electrode is eccentrically arranged in relation to the cross section of the outer electrode so that the two toroids have a common axis of symmetry. The greatest distance between the two electrodes is at least twice as big as the smallest distance between the two electrodes. (Gmelin Inst.)

10219 PRODUCTION OF COMPLETELY IONIZED PLASMA. **Alexeff, I.; Neidigh, R. V. (to U. S. Atomic Energy Commission). U. S. Patent 3,222,559. Dec. 7, 1965.**

A means for obtaining a neutral-free, energetic, and magnetically confined, steady-state plasma for the heating of ions and the production of neutrons is discussed. An improvement was made in the Mode II arc discharge by increasing the volume of the anode and centering the anode between magnetic mirror coils. The cathode was left in the same relative position. Feed gas is admitted to the center of the anode, midway between the mirror coils. The "pressure gradient" occurs between the center of the anode, where the gas is fed, and the exterior volume at both ends through the mirror coils. With a proper gas feed rate, magnetic field, and vacuum pressure differentials between the anode volume and the anode exterior volume, a neutral-free, steady-state plasma is provided in the operation of such a device, and the ions created thereby are sufficiently energetic to produce a substantial quantity of neutrons.(AEC)

Shielding

10220 (AED-C-01-11) AUSGEWAEHLTES SCHRIFTTUM NACH SACHGEBIETEN. BAUWESEN. STRAHLENABSCHIRMUNG. TEIL VI. **(Selected Literature on Subjects. Architecture. Radiation Shielding. Part VI). (Fraunhofer-Gesellschaft, Stuttgart (West Germany)). 1965. 90p. Dep. mn.**

Eighty references with abstracts are given to articles published in Trans. Am. Nuc. Soc. from Nov. 1962 through Nov. 1964. Author and subject indexes are included. (P.C.H.)

10221 (NP–15692) THE ATTENUATION OF THERMAL NEUTRONS IN CYLINDRICAL DUCTS THROUGH A WATER SHIELD. Horton, C. C.; Halliday, D. B. (Atomic Energy Research Establishment, Harwell (England)). Jan. 1956. 12p. Dep. mn.

The attenuation of thermal neutrons in air filled cylindrical ducts in a water shield was studied. The ducts varied in length up to 56 radii, and were bent through angles varying from 10 up to 90°. It is found that the attenuation in a duct at a distance Z radii after a bend of $\theta°$ is given by $\phi/\phi_0 = (\gamma/\sin\theta)(1/Z)^2(1 + (\delta/Z))$, for $3 < Z < 30$ and $10° < \theta < 90°$. ϕ/ϕ_0 is the ratio of flux to flux at the bend, and γ, δ are functions of the albedo of the shield material only. (auth)

10222 (ORNL–3852) CALCULATION OF THE NUCLEON-MESON CASCADE IN IRON INITIATED BY 1- AND 3-Gev PROTONS AND COMPARISON WITH EXPERIMENT. Alsmiller, R. G. Jr.; Barish, J. (Oak Ridge National Lab., Tenn.). Dec. 1965. Contract W-7405-eng-26. 15p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

One-dimensional nucleon-meson cascade calculations were carried out for the cases of 1- and 3-Bev protons incident on steel. The thick target cross sections are calculated and compared with experimental values. The calculated values are generally larger than the experimental values for large depths. (auth)

10223 (ORNL-P–1787) CALCULATED FLUXES OF LESS THAN 50-Mev NEUTRONS DIFFUSING BENEATH THE SHIELD OF A MESON PRODUCTION FACILITY. Kinney, W. E. (Oak Ridge National Lab., Tenn.). [1965]. Contract W-7405-eng-26. 8p. (CONF-651101–49). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

From 13th Conference on Remote Systems Technology, Washington, D. C.

A Monte Carlo calculation was performed in an attempt to estimate the effect of the "earthshine" in an idealized but useful shield configuration. Some crude biasing techniques were employed in an effort to improve the results. The methods used in this calculation are discussed and some results and conclusions are presented. (M.O.W.)

10224 (ORNL-TM-1196) SOME CONCLUSIONS REGARDING THE USE OF THE S_n METHOD IN SHIELDING CALCULATIONS. Webster, J. Wallace (Oak Ridge National Lab., Tenn.). Sept. 15, 1965. Contract W-7405-eng-26. 56p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

Neutron penetration in hydrogen and water from a point source of fission neutrons was studied using the S_n method. The results were compared with results obtained using the moments method. (D.C.W.)

10225 AN EXPERIMENTAL DETERMINATION OF THE ABSORPTION AND BUILDUP FACTOR IN WATER FOR RADIUM, ^{60}Co, AND ^{137}Cs GAMMA RAYS. Ponnunni Kartha, K. I.; Kenney, Gordon N.; Cameron, John R. (Univ. of Wisconsin, Madison). Amer. J. Roentgenol., Radium Therapy Nucl. Med., 96: 66-9(Jan. 1966).

Lithium fluoride thermoluminescent dosimeters were utilized to determine the combined absorption and buildup factors for three clinically important radioisotopes. The study discloses significant departures from the results predicted by the inverse square law when these radioisotopes are used in a water medium. For these sources the buildup is insufficient to compensate for absorption. An empirical equation was evaluated for AB which fits the experimental data to within 3.2 per cent. If absorption and buildup are neglected in dosimetry calculations for interstitial or intracavitary uses, over-estimation of the dose occurs. These errors may be reduced by using the experimentally determined AB factors listed or calculated values using the equation. (TCO)

10226 POSSIBILITIES OF USING SOLUTIONS OF BARIUM CHLORIDE AND ZINC CHLORIDE INSTEAD OF LEAD GLASS. Benes, J.; Chodounsky, Z.; Pacltova, M. (Onkologicke Oddeleni Fakultni Nemocnice, Prague). Cesk. Radiol., 18: 59–61(Jan. 1964). (In Czech).

Solutions of $ZnCl_2$ (25%) and $BaCl_2$ (saturated) were prepared in distilled water and their absorption properties compared with that of Pb glass, using a ^{137}Cs source. Results of percentage absorption of radiation from a 2.5 to 4.5 R/min source for varying absorber thicknesses are given. $BaCl_2$ is found to be particularly suited for substitution of Pb glass in a layer 3.5 to 4 cm deep, since it has the same absorption range, is stable and completely transparent, and requires no care except for occasional refilling of the distilled water which has evaporated. (BBB)

10227 ON THE INFLUENCE OF WATER CONTENT ON THE RADIATION ATTENUATION IN CONCRETE SHIELDS. Seboek, F. (Technische Hochschule, Hanover). Kerntechnik, 7: 496-8(Nov. 1965). (In German).

In order to obtain an indication of how the shielding properties are altered, calculations were made for two concretes, normal sandy concrete and iron ore concrete, each with normal and high water concentrations at the temperatures of 20, 100, and 200°C. The results are tabulated and graphed and show that the shielding thickness necessary for high temperatures depends strongly on the given shielding ratios. (J.S.R.)

10228 DOSE BUILD-UP FACTORS FOR LEAD, STEEL, AND WATER. Hoenig, A. (Technische Hochschule, Brno). Kerntechnik, 7: 506-14(Nov. 1965). (In German).

The dose build-up factors for lead, steel, and water were calculated for quanta energies between 0.5 and 10.0 Mev and layer thicknesses from 0 to 50 cm. The results are tabulated. (J.S.R.)

10229 SYMPOSIUM ON CONCRETE FOR RADIATION SHIELDING. Polivka, Milos (Univ. of California, Berkeley). 4p. (CONF-650602–76). ORINS. Gmelin, AED-CONF-65-125-100.

From American Nuclear Society 11th Annual Meeting, Gatlinburg, Tenn.

A brief review is given of radiation shielding requirements, and various types of concrete shielding materials. The symposium is briefly summarized. Conventional concretes are not covered in detail, but a summary of the art of using shielding concretes is given. Topics discussed represent laboratory and field data as well as field experiences in the use of concrete for radiation shielding. (J.F.P.)

Solid State Physics

See also CHEMISTRY — Inorganic and Physical Chemistry
METALS, CERAMICS, AND OTHER MATERIALS — Properties and Structure

Refer also to abstract 10064.

10230 (NYO–2471-11) ULTRASONIC ABSORPTION IN SODIUM CHLORIDE [Thesis]. Report No. 410. Moog, Robert Arthur (Cornell Univ., Ithaca, N. Y. Materials Science Center). Sept. 1965. Contract AT(30-1)-2471. 144p. Dep. mn; CFSTI $4.00 cy, $1.00 mn.

The ultrasonic attenuation in sodium chloride was measured as a function of frequency, temperature, and dose of gamma irradiation. The dependence of the attenuation upon amount of plastic deformation, orientation of specimen, and time after deformation, was also observed. Experimental techniques (pulse echo method) for the measurement of the ultrasonic attenuation in the frequency range 5–150 Mc/sec, and in the temperature range 5–300°K, and the preparation of sodium chloride specimens to which special attention had to be paid, are described.

The non-dislocation contributions to the attenuation, i.e., the attenuation observed when the dislocations are pinned are discussed in terms of beam spreading, scattering from inhomogeneities, phonon scattering, and other phenomena. The dislocation contribution was interpreted in terms of the Granato-Lücke theory (damped string model). The frequency and orientation dependence of the decrement agreed with the theory to within the experimental error. A value for B (dislocation drag force) was computed and turned out to be of the same order of magnitude as in Cu. The temperature dependence of the decrement however did not agree with existing theories of others. The dependence of the decrement upon gamma irradiation revealed two components, one of which followed the Granato-Lücke theory, while the other did not. (auth)

10231 NEUTRON DIFFRACTION OF MAGNETIC COMPOUNDS. Austin, Alfred E. Battelle Tech. Rev., 14: 13-17(Dec. 1965).

The fundamentals of neutron diffraction are discussed, along with the results obtained from magnetic compounds of iron with germanium, silicon, and tin. (L.B.S.)

10232 THE INTERACTION OF HOT ELECTRONS WITH A FREE ELECTRON GAS. Ritchie, R. H.; Ashley, J. C. (Oak Ridge National Lab., Tenn.). J. Phys. Chem. Solids, 26: 1689-94(Dec. 1965). (ORNL-P-1026).

The interaction probability of an electron excited only slightly above the Fermi surface of an electron gas is determined using standard methods of many-body perturbation theory. The effect of exchange processes on the mean free path is found to be negligible in the high density limit. However, the energy distribution of an electron after scattering on the electron gas is quite different even in the high density limit when exchange is included. (auth)

10233 OPTICAL STUDIES OF ELECTRON AND HOLE TRAPPING LEVELS IN QUARTZ. Schlesinger, Mordechay (Univ. of Pittsburgh). J. Phys. Chem. Solids, 26: 1761-6 (Dec. 1965).

Illumination with monochromatic light into various color-center absorption bands of quartz at liquid nitrogen temperature (LNT) after previous x irradiation at room temperature (RT) re-excites some glow peaks of the usual glow-curve in the region between LNT and RT. Re-excitation can also be performed for peaks above the temperature at which the crystal was x-irradiated. The effect was investigated in detail for crystals doped with various impurities and under various conditions. The results are in agreement with the generally accepted models for the electronic processes in quartz. (auth)

10234 THERMAL VIBRATION AMPLITUDES IN FLUORITE LATTICES. Pryor, A. W. (Australian Atomic Energy Research Establishment, Sutherland, New South Wales). J. Phys. Chem. Solids, 26: 2045-9(Dec. 1965).

Calculations are presented of the thermal vibration amplitudes of the atoms in the two fluorite structures CaF_2 and UO_2. The calculations are carried out by setting up the dynamic matrix for a rigid-ion model with effective charges and calculating the eigenvalues and eigenvectors at a number of points in reciprocal space. The computed B-factors are compared with those found by Willis et al., from neutron diffraction experiments. Willis's hypothesis of a shift in the position of the anions along ⟨111⟩ directions is rejected: first, on the grounds that it leads to vibration amplitude values which disagree with calculated values; second, on the basis of an approximate calculation of the asymmetry of the interatomic potential in this direction and the resulting shift in position which such an asymmetry would cause. (auth)

10235 THE MOESSBAUER EFFECT IN METALLIC TIN AT PRESSURES UP TO 110 kbar. Panyushkin, V. N.; Voronov, F. F. (Inst. of High Pressure Physics, Academy of Sciences, USSR). JETP Lett. (USSR) (Engl. Transl.), 2: 97-9(Aug. 15, 1965).

The Mössbauer effect was observed in tin (β-Sn). The Doppler shift of the gamma quantum energy was produced by moving a resonant absorber relative to the source. The resonance curves for each experiment were plotted at pressures of 1 atm, and 45, 90, and 110 kbar. Sample resonance curves for different pressures are shown. The pressure dependence on the probability of recoilless gamma quantum emission, and on the effective Debye temperature are shown. Also the pressure dependence on the position of the resonance line of β-Sn relative to the energy of the resonance in SnO_2 is given. It is noted that all the pressure effects observed in β-Sn are fully reversible within the limits of error. (J.F.P.)

10236 CHANGE IN THE PROBABILITY OF THE MOESSBAUER EFFECT ON ^{119}Sn IMPURITY NUCLEI IN THE FERROELECTRIC PHASE TRANSITIONS IN $BaTiO_3$. Chekin, V. V.; Romanov, V. P.; Verkin, B. I.; Bokov, V. A. (Physico-Technical Inst. of Low Temperatures, Academy of Sciences, Ukrainian SSR). JETP Lett. (USSR) (Engl. Transl.), 2: 117-19(Aug. 15, 1965).

The temperature variation of the probability of the Mössbauer effect on tin-119 impurity nuclei in the $Ba(Ti_{0.99}Sn_{0.01})O_3$ system near the ferroelectric phase-transition temperature was investigated. The temperature dependence of the relative Mössbauer-effect probability on the dielectric constant, and on the dielectric loss tangent for the system studied are shown. It is seen that the relative Mössbauer effect probability decreases quite sharply on approaching the Curie point from the para-electric region, passes through a minimum, and then begins to grow with decrease in temperature in the usual manner. This observed singularity can be attributed to the temperature dependence of the frequency of the anomalous optical branch. A comparison of results with earlier measurements confirms the hypothesis that the phase transition in solid solutions of the system studied is considerably smeared. (J.F.P.)

10237 ANISOTROPY OF THE MOESSBAUER EFFECT IN SINGLE CRYSTALS OF TIN AT LOW TEMPERATURES. Alekseevskii, N. E.; Kir'yanov, A. P.; Nizhankovskii, V. I.; Samarskii, Yu. A. (Inst. of Physics Problems, Academy of Sciences, USSR). JETP Lett. (USSR) (Engl. Transl.), 2: 171-4(Sept. 15, 1965).

The results of measurements of resonant absorption of recoilless 23.8-kev-γ rays produced by the decay of ^{119m}Sn in single crystals of tin, in the temperature interval 4.2 to 280°K, are reported. The measurements were made with a setup in which the absorber was caused to move at constant speed relative to the source. Typical resonance-absorption curves for the absorbers at 4.2°K and the temperature dependence of the amplitude of the maximum absorption in single-crystal absorbers are shown. The presence of anisotropy of the Mössbauer effect at 4.2°K was established. The magnitude of this anisotropy is given, and it is found to go through an inversion in the region $T = (40 \pm 5)$°K. The temperature dependence of the Mössbauer effect anisotropy can probably be attributed to an overlap of the optical and acoustical branches of the phonon spectrum of tin. (J.F.P.)

10238 ON THE POSSIBILITY OF AN OPTICAL SHIFT OF THE MOESSBAUER-SPECTRUM LINES. Bersuker, I. B.; Kovarskii, V. A. (Inst. of Applied Physics, Moldavian Academy of Sciences, USSR). JETP Lett. (USSR) (Engl. Transl.), 2: 182-3(Sept. 15, 1965).

It is proposed to use the Mössbauer spectra of γ-resonance nuclear absorption to investigate the excited states of the electron shell and to determine certain kinetic parameters of the system by measuring the optical shift — the change induced by sufficiently strong light in the spectrum of a source or an absorber of γ quanta in the optical excitation band. Important information can be obtained from the dependence of the intensity ratio of the shifted and fundamental Mössbauer spectra lines (which is equal to the ratio of the populations of the excited and ground state electronic levels) on the illumination power. If this dependence is known, the probability of nonradiative transition between the electronic states can be determined on the basis of the kinetic equation, for example. (J.F.P.)

10239 PURE QUADRUPOLE RESONANCE FREQUENCY SHIFT AND INTERNAL STRESS IN GAMMA-RAY IRRADI-

ATED SODIUM CHLORATE. Budak, Hayati (Univ. of Istanbul). Nature, 208: 382(Oct. 23, 1965).

The results of measurements of the pure quadrupole resonance frequency shift of ^{35}Cl in sodium chlorate crystals due to gamma irradiation are reported. The stress produced for γ-doses of 10^6R in the Na−Cl direction was found to be $\sigma_{33} \cong 23$ kg/cm² MR. (L.B.S.)

10240 THE TOPOGRAPHY OF RADIATION UNDER MECHANICAL DE-EXCITATION OF ALKALI-HALIDE CRYSTAL PHOSPHORS PREIRRADIATED BY BETA RAYS. Michalchenko, G. A.; Misyurev, Yu. A.; Toropov, N. A.; Udalov, Yu. P. Opt. Spectros. (USSR)(Engl. Transl.), 18: 601-2(June 1965).

Translated from Opt. Spektros., 18: 1072-3(June 1965).

Experiments were conducted using beta-irradiated CeI−In, CsI−In, and CsI crystals, in which luminous rosette patterns were observed under mechanical de-excitation, using the technique of contact photography. Similar patterns were observed for NaCl−Eu, KBr−Eu, and KI−In crystals. It was established that by pricking alkali−halide crystal phosphors a luminous prick (impact) rossette is observed, whose shape agrees with the model of the moving edge dislocation crossing the surface. (L.B.S.)

10241 FLUORESCENCE SPECTRUM OF TRIVALENT VANADIUM IN CORUNDUM. Goldschmidt, Z.; Low, W.; Foguel, M. (Hebrew Univ., Jerusalem). Phys. Lett., 19: 17-18(Sept. 15, 1965).

The fluorescence spectrum of single crystals of Al_2O_3 containing 0.5-1 at % V^{3+} was measured using a high-pressure Hg discharge lamp as an excitation source. (G.O.Y.)

10242 PARAMAGNETIC RESONANCE OF RARE EARTH IONS IN CERIUM OXIDE. Komet, Y. (Hebrew Univ., Jerusalem); Low, W.; Linares, R. C. Phys. Lett., 19: 473-4(Dec. 1, 1965).

The ESR spectra of Er^{3+}, Yb^{3+}, and Gd^{3+} present as small impurities (less than 0.01%) in single crystals of CeO_2 were investigated. These spectra were all measured at 20 and 290°K and 3 cm wavelength. The main results are listed. Results for the same ions in ThO_2 and in CaF_2 are also shown and compared. There is great similarity in the spectra of the rare earth ions in ThO_2 and in CeO_2, although the crystal lattice spacings differ by about 4%. The differences for these ions is larger in CaF_2 although the unit cell size of these lattices are very similar. Also the experimental g factors are lower, for Er^{3+} and Yb^{3+}, and in the case of Yb^{3+} at least in close agreement with the theoretical value. These results are discussed. (J.F.P.)

10243 THE ELECTRO-OPTIC EFFECT OF SODIUM URANYL ACETATE. Warner, J.; Robertson, D. S.; Parfit, H. T. (Royal Radar Establishment, Malvern, Eng.). Phys. Lett., 19: 479-80(Dec. 1, 1965).

The electro-optic coefficient of sodium uranyl acetate, which is a cubic molecular crystal relatively insoluble in water, was evaluated. This was done in order to determine materials which might modulate coherent or incoherent light, using the linear or Pockels electro-optic effect more efficiently than potassium or ammonium dihydrogen phosphate. The experimental results indicate that sodium uranyl acetate has electro-optical properties considerably inferior to those of potassium and ammonium dihydrogen phosphate and cuprous chloride. It is relatively easy to grow optical quality crystals, but the small electro-optic coefficient and the fact that it is optically active discourages exploitation in optical modulation devices. (J.F.P.)

10244 EFFECT OF FAST NEUTRON BOMBARDMENT ON THE FERROELECTRIC TRANSITION BEHAVIOUR IN $BaTiO_3$. Weik, H.; Schneider, J. (Univ. of Cincinnati). Phys. Lett., 19: 619-20(Jan. 1, 1966).

Multidomained single crystal $BaTiO_3$ butterfly wing samples, which had been converted into single c-domain specimens by the Campbell method, were exposed to directional fast-neutron irradiation of integrated dosages between 10^{17} and 10^{19} nvt, and subsequently the structural behavior near the 120°C ferroelectric Curie temperature was investigated. The results of divergent beam measurements of the d_{004}-spacings showed that the irradiation caused an increase of the interplanar spacings, and that greater than 10^{19} nvt, the structural variations are a rapidly changing function of dosage. (L.B.S.)

10245 MAGNETIC PROPERTIES OF TmP, TmAs AND TmSb. Busch, G. (Eidgenoessisches Technische Hochschule, Zurich); Menth, A.; Vogt, O.; Hulliger, F. Phys. Lett., 19: 622-3(Jan. 1, 1966).

A model is proposed to explain the magnetic behavior of TmP, TmAs, and TmSb, based on the hamiltonian where the crystal-field and external-field hamiltonian are treated as one perturbation of the free-ion hamiltonian. Eigenvalues were calculated for sets of values of the overall splitting between the highest and the lowest crystal-field level, the mixing parameter, and the external field. Calculated magnetization and susceptibility curves show good agreement with measured curves. (L.B.S.)

10246 THEORY OF THE FIRST-ORDER MAGNETIC PHASE CHANGE IN UO_2. Blume, M. (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 141: 517-24 (Jan. 1966). (BNL-9428).

A simple model accounts semiquantitatively for the first-order magnetic phase change observed recently in UO_2 by Frazer, Shirane, Cox, and Olsen. The model assumes that the electronic structure of the paramagnetic U^{4+} ion consists of a nonmagnetic singlet ground state and a low-lying magnetic triplet, and that only bilinear isotropic exchange interactions are present. In a molecular-field theory the triplet is split by an internal field proportional to the magnetization. If the molecular field is sufficiently strong, one of the components of the triplet will lie, in the magnetic state, below the singlet, and a self-consistent magnetic solution is obtained at T = 0. Increasing the temperature causes the magnetization to be reduced, and the low-lying component of the triplet is raised in energy. It is shown that a "catastrophe" may occur at some critical temperature so that the magnetization is reduced discontinuously to zero. It is also found that, depending on the ratio of the singlet-triplet energy difference to the molecular-field splitting of the triplet, one obtains either no magnetic ordering, a first-order phase change, or a second-order transition. (auth)

10247 ELECTRON SPIN RESONANCE IN CERIUM METAL. Goodrich, Roy G.; Everett, Glen E. (Univ. of California, Riverside). Phys. Rev., 141: 541-7(Jan. 1966).

The electron-paramagnetic-resonance spectrum of pure polycrystalline metallic cerium was obtained at atmospheric pressure and at the temperatures 300, 196, and 77°K using a standard 1.25-cm microwave spectrometer in magnetic fields up to 26.5 kG. In order to interpret the results it is necessary to consider the effects of both the crystalline field and the exchange interactions which act on the 4*f* electrons. It is found that the cubic phase existing at atmospheric pressure and room temperature has a small trigonal distortion. In addition a series of satellite resonances are observed which are due to an indirect exchange interaction between ions having their 4*f* electrons in the different Stark levels produced by the crystalline field. Resonances were also observed from the hexagonal phase which coexists with the cubic phase at the temperatures investigated. The hexagonal-phase results agree with the predictions of crystal-field theory. The measured g factors are: $g_{||} = 1.29$, $g_{\perp} = 1.07$ for the -fcc phase (trigonal distortion); $g_{||} = 4.25$, $g_{\perp} = 0.6$, and $g_{||} = 1.26$, $g_{\perp} = 2.14$ for the -hexagonal phase. The 4*f* conduction-electron exchange energy for the fcc phase at 300°K is $\bar{I} = -0.062$ ev. (auth)

10248 INFLUENCE OF HYDROSTATIC PRESSURE ON MAGNETIC TRANSITIONS IN TERBIUM AND DYSPROSIUM. Robinson, Lawrence Baylor; Tan, Swie-In (Univ. of California, Los Angeles). Phys. Rev., 141: 548-53 (Jan. 1966).

The effect of hydrostatic pressure on the magnetic transitions in terbium and dysprosium was investigated. The transformer method is used, in which the toroidal core of the miniature transformer is the rare-earth metal itself. Results are obtained as curves of secondary voltage versus temperature. A cusp in the secondary voltage indicates the occurrence of a Néel temperature, at

which a transformation takes place from a paramagnetic to an antiferromagnetic state, while a sharp rise in the secondary voltage indicates the passage through a Curie temperature, where a transformation from an antiferromagnetic to a ferromagnetic state occurs. The pressures, up to 25 kbar, are obtained by the piston-cylinder technique, using silver chloride as the pressure-transmitting medium. The temperature range is from 40°K to room temperature. This has been achieved with the use of a new 4-wall cryogenic Dewar and liquid helium as coolant. The pressure coefficient of the transition temperature of terbium is found to be −1.0°K/kbar. Under pressure, the atmospheric Néel temperature either disappears or, because of the narrowness of the antiferromagnetic region, is difficult to separate from the Curie temperature. The pressure coefficient of the Néel temperature for dysprosium is −0.4°K/kbar. In the range of from zero to about 7 kbar, the Curie temperature appears to increase with increasing pressure; beyond 7 kbar, the Curie temperature appears to decrease with increasing pressure. In the low-pressure range, the pressure coefficient of the Curie temperature appears to be positive, and in the high-pressure range it is −0.8°K/kbar. The above results involving measurements on dysprosium must be taken as tentative. The shape of the secondary-voltage-versus-temperature curves is such that one cannot assign the coefficients in an unambiguous manner. (auth)

10249 CORE-POLARIZATION CONTRIBUTION TO THE KNIGHT SHIFT IN BERYLLIUM METAL. Shyu, Wei-Mei; Gaspari, G. D.; Das, T. P. (Univ. of California, Riverside). Phys. Rev., 141: 603-15(Jan. 1966).

Direct and core-polarization contributions to the Knight shift in beryllium metal were calculated at a number of symmetry points near the Fermi surface. The direct contribution was evaluated using wave functions for the conduction electrons by the orthogonalized-plane-wave method. The contribution of the core electrons was determined using the moment-perturbation (MP) method developed in an earlier paper. The accuracy of the MP method was rechecked by calculating the core contribution to the hyperfine coupling constant in the $^3P_2$ state of the beryllium atom. Good agreement was obtained with the result of an earlier self-consistent-field calculation by Goodings. For the Γ_4^- level, the direct and core contributions to the Knight shift are 0.01536 and 0.00258%, respectively. For the two degenerate levels of H_1, the direct contributions both vanish while the core-polarization contributions are −0.00061 and −0.00001%. These results lead to the conclusion that core-polarization effects alone can not explain the near-vanishing Knight shift observed experimentally in beryllium metal. Some other contributions such as those from various orbital mechanisms would therefore have to be considered. (auth)

10250 PIEZORESISTIVE PROPERTIES OF REDUCED STRONTIUM TITANATE. Tufte, O. N.; Stelzer, E. L. (Honeywell Research Center, Hopkins, Minn.). Phys. Rev., 141: 675-80(Jan. 1966).

The piezoresistance effect was investigated in reduced single-crystal strontium titanate in the temperature range from 4.2 to 296°K. At 296°K, the elastoresistance coefficients $(m_{11} - m_{12})$, m_{44}, and $(m_{11} + 2m_{12})$ were evaluated in samples having a wide range of electron concentrations. The piezoresistance results indicate that the conduction-band edge consists of two types of energy minima separated by several hundreths of an ev with the minimum at k = 0 being the lowest in energy. Below approximately 110°K, the piezoresistance effect becomes very anisotropic and for certain crystallographic directions, a saturation of the piezoresistance is observed at stress values between 1×10^8 and 2×10^8 dyn/cm^2. The low-temperature piezoresistive properties appear to be a result of the cubic-to-tetragonal phase transition and it is postulated that these effects are due to a stress-induced alignment of the tetragonal domains. (auth)

10251 ROOM-TEMPERATURE DEFORMATION LUMINESCENCE IN ALKALI HALIDES. Butler, C. T. (Oak Ridge National Lab., Tenn.). Phys. Rev., 141: 750-7(Jan. 1966). (ORNL-P-1524).

Emission of light by crystals mechanically deformed at room temperature after γ irradiation at 35°C was studied. Spectra of several alkali halides were measured, and the intensity of the luminescence investigated in relation to γ dose, strain, and strain rate. The deformation luminescence (DL) intensity becomes nearly constant beyond a certain value of plastic strain, and varies as a fractional power of the strain rate. Coloration, bleaching, annealing, and other studies show that the DL is related to F and M centers but also depends upon the presence of another, unidentified center. (auth)

10252 V CENTERS IN POTASSIUM BROMIDE CRYSTALS. Ishii, T.; Rolfe, J. (National Research Council, Ottawa). Phys. Rev., 141: 758-67(Jan. 1966).

The nature of V centers stable at room temperature in KBr crystals was investigated by means of preferential bleaching with polarized light. V centers were produced by ionizing radiation, by electrolysis with a pointed anode, or by additive coloration with bromine at high pressure. In pure KBr crystals, the properties of V centers depended on the method of production. Two absorption bands of ⟨100⟩-type symmetry were formed at 253 and 278 mμ both by electrolysis and by additive coloration, but no corresponding bands could be found in irradiated crystals. The main product of additive coloration was a broad absorption band extending from the fundamental absorption edge to 320 mμ, appearing in all crystals, pure or doped, which is attributed to bromine molecules. It is suggested that this band forms a large part of the broad absorption band produced by prolonged irradiation of pure crystals, usually referred to as the V_2 and V_3 bands. Furthermore it was shown that the V_3 band is not caused by hydride ions. In KBr doped with alkaline-earth impurities an absorption band which does not depend on the method used to introduce V centers appeared at 262 mμ in KBr(Ca) and KBr(Sr) and at 267 mμ in KBr(Ba). This band has ⟨100⟩-type dichroism at 78°K. Optical bleaching of this band at room temperature produced two overlapping bands arising from a common center with ⟨111⟩-type dichroism at 78°K. Possible models of the centers responsible for these bands are discussed. (auth)

10253 COLOR CENTERS IN TlCl. Christy, R. W.; Dimock, J. D. (Dartmouth Coll., Hanover, N. H.). Phys. Rev., 141: 806-14(Jan. 1966).

Although TlCl is thought to contain an equilibrium number of anion vacancies which is comparable with the alkali halides, no F centers can be produced in pure TlCl, either by x-ray irradiation at 100 or 300°K, or by addition of excess Tl metal. Addition of chalcogen impurities, however, produces an absorption peak in crystals quenched from high temperature. This peak lies at 409 mμ in TlCl : Tl_2S and at 420 mμ in TlCl : Tl_2Se, with oscillator strengths of 0.22 and 0.27, respectively; the peak narrows and the position shifts when the absorption is measured at lower temperature. The direction of the temperature shift is unusual, in that it moves toward longer wavelength at low temperature. As the quenched crystal approaches equilibrium at room temperature, the peak transforms into another band whose peak is hidden by the fundamental absorption. This band is identical for the sulfur- and selenium-doped crystals, and it is independent of the temperature of measurement. At intermediate temperatures, the equilibrium absorption is a mixture of the two bands, which have an isosbestic point at 455 mμ. At room temperature the transformation occurs in the dark, although its rate is accelerated by illumination with white light. In both cases the rate is faster for the sulfur-doped crystals than for the selenium-doped ones. Similar bands are observed in TlBr : Tl_2S and TlBr : Tl_2Se, although in this case all the peaks are hidden by the fundamental absorption. The room-temperature absorption, which is independent of the impurity and of temperature, is interpreted as due to colloidal Tl metal. The high-temperature peak, which is capable of reversible transformation into the colloid band, is interpreted as due to F centers associated with S^- or Se^- impurity ions. The transforma-

tion to the colloid absorption results from coagulation of the F centers. With this explanation, some comparisons are drawn with F centers in the cesium halides on one hand, and with the impurity absorption bands in chalcogen-doped silver halides on the other hand. (auth)

10254 THE GROUND STATE OF SOLID ^{3}He AND THE EXCHANGE INTERACTIONS BETWEEN NUCLEAR SPINS OF ^{3}He. Garwin, Richard L. (Columbia Univ., New York); Landesman, Andre Physics, 2: 107-29(Nov. 1965).

Of the published theories of solid ^{3}He, that of Saunders has been shown to give an a priori prediction of the exchange interaction in fairly good agreement with the experimental results. The theory is improved upon in three ways: (1) by using the correct ^{3}He–^{3}He pair wave function, which is quite different from that used by Saunders; (2) by computing explicitly the single-particle projection of the many-body wave function, rather than replacing it with a Gaussian of equal curvature at the lattice site; and (3) by calculating the exchange integral J by numerical integration from the detailed wave function of (2), rather than by the use of a Gaussian. These changes do not make the agreement with observation significantly better, but, since the underlying theory has no very firm basis, these calculations should be regarded as an example of what is still required to calculate J if one has a good theory of the solid. As for properties other than the exchange interaction, in the case of the bcc phase calculated the Debye temperature was calculated to be $\theta = 26.0(v/20)^{-2.285}$, as compared with the experimental $\theta_{exp} = 28.5(v/20)^{-2.50}$. (auth)

10255 AN INVESTIGATION OF THE MAGNETIC STRUCTURE OF URANIUM NITRIDE BY NEUTRON DIFFRACTION. Curry, N. A. (Atomic Energy Research Establishment, Harwell, Eng.). Proc. Phys. Soc. (London), 86: 1193-8(Dec. 1965).

The magnetic structure of uranium nitride at liquid helium temperature was studied by neutron diffraction. It is found that this substance is antiferromagnetic with ordering of the first kind. A value of 0.75 μ_B was found for the magnetic moment at a uranium atom, and a form factor was obtained. Good agreement is found between the experimental form factor and a theoretical calculation based on the assumption that the uranium atoms are triply ionized and have a $5f^3$ configuration. (auth)

10256 ELECTRONIC SHIELDING OF THE CRYSTALLINE ELECTRIC FIELD IN RARE EARTH IONS. Ghatikar, M. N.; Raychaudhuri, A. K.; Ray, D. K. (Saha Inst. of Nuclear Physics, Calcutta). Proc. Phys. Soc. (London), 86: 1235-8(Dec. 1965).

The effect of electronic shielding on the A_2^0 term of the crystal field potential of the Pr^{3+} and the Tm^{3+} ion was estimated from the numerical solution of the first-order perturbation equation. The shielding factor σ_2 is 0.59 and 0.70 for Tm^{3+} and Pr^{3+} respectively. The results stress the importance of electronic shieldings in rare-earth ions in agreement with the experimental findings of Barnes et al. (auth)

10257 NUCLEAR QUADRUPOLE SHIELDING FACTORS FOR TRIVALENT RARE EARTH IONS. Ghatikar, M. N.; Raychaudhuri, A. K.; Ray, D. K. (Saha Inst. of Nuclear Physics, Calcutta). Proc. Phys. Soc. (London), 86: 1239-47(Dec. 1965).

The Sternheimer R factor, which takes account of the distortion of closed shells of electrons by the nuclear quadrupole moment and the consequent modification of the field gradient produced by the 4f electrons at the nuclear site, was estimated theoretically for Pr^{3+} and Tm^{3+} ions. Both angular and radial excitations of the various closed orbitals were calculated by numerical solution of corresponding first-order Schrödinger equations. The magnitudes of R factors for Pr^{3+} and Tm^{3+} ions are 0.20 to 0.15 respectively and the sign is positive for both indicating shielding rather than anti-shielding of the 4f field gradients. This magnitude for the Tm^{3+} ion is in good agreement with the semi-experimental value of 0.11 obtained by Barnes, Mössbauer, Kankeleit and Poindexter for Tm^{3+} in thulium ethyl sulfate from quadrupole splitting of Mössbauer lines. The possibility of change in the value of the R factor for rare earth ions due to covalent bonding is also pointed out. (auth)

10258 COLOUR CENTRES IN MAGNESIUM-DOPED LITHIUM FLUORIDE. Mort, J. (Central Electricity Research Labs., Leatherhead, Eng.). Solid State Commun., 3: 263-6(Sept. 1965).

Optical absorption measurements on x-irradiated single crystals of LiF doped with magnesium are reported. Absorption bands at 5.5 and 4.0 ev are shown to be associated with the presence of the magnesium and are greatly enhanced if the crystals are quenched prior to x irradiation. (auth)

10259 EXPLANATION OF THE HALL EFFECT OF $LaCoO_3$ IN THE POLARON PICTURE. Hardtl, K. H.; Gerthsen, P. (Philips Research Labs., Aachen). Solid State Commun., 3: 283-4(Sept. 1965).

The Hall effect and electric conductivity of several p-type $LaCoO_3$ samples with different dopings of Sr were measured. Particularly at low temperatures, significant differences occur between Hall mobility and drift mobility; even the temperature coefficients of the mobilities are different. The Hall mobility, especially its temperature dependence, agrees satisfactorily with Schnakenberg's theory. (D.C.W.)

10260 MOESSBAUER SPECTRA IN THE PRESENCE OF ELECTRIC QUADRUPOLE AND MAGNETIC INTERACTIONS. Bykov, G. A.; Ryasnyin, G. K.; Shpinel, V. S. (Moscow State Univ.). Soviet Phys.-Solid State (Engl. Transl.), 7: 1343-7(Dec. 1965).

Translated from Fiz. Tverd. Tela, 7: 1657-62(June 1965).

The primary doublet structure of a Mössbauer spectrum was studied by placing a polycrystalline absorber of $(C_6H_5)_2SnCl_2$ in a magnetic field. A theoretical analysis was performed by which some general properties of Mössbauer spectra in the presence of electric quadrupole and magnetic interactions were demonstrated. (D.C.W.)

10261 INFLUENCE OF THE CRYSTAL STRUCTURE OF THE TARGET ON THE ENERGY SPECTRA OF SCATTERED IONS. Mashkova, E. S.; Molchanov, V. A. (Moscow State Univ.). Soviet Phys.-Solid State (Engl. Transl.), 7: 1506-7(Dec. 1965).

Translated from Fiz. Tverd. Tela, 7: 1872-4(June 1965).

The results obtained in a study of the scattering of singly charged neon ions at 30 kev by crystalline copper targets of various orientations are presented. (D.C.W.)

10262 THE MOESSBAUER EFFECT IN ^{119}Sn NUCLEI IN FERROELECTRIC PHASE TRANSITIONS IN THE SOLID SOLUTION $Ba(Ti_{0.8}, Sn_{0.2})O_3$. Bokov, V. A.; Romanov, V. P.; Chekin, V. V. (Kharkov Inst. of Physics and Tech. of Low Temperatures. Inst. of Semiconductor, Leningrad). Soviet Phys.-Solid State (Engl. Transl.), 7: 1521-2(Dec. 1965).

Translated from Fiz. Tverd. Tela, 7: 1886-8(June 1965).

Mössbauer absorption by ^{119}Sn nuclei in polycrystalline samples of the solid solution $Ba(Ti_{0.8},Sn_{0.2})O_3$ was studied. The temperature dependence of the probability of the Mössbauer effect was considered in detail. (D.C.W.)

10263 NUCLEAR-MAGNETIC-RESONANCE INVESTIGATIONS OF THE TRIFLUORIDES OF RARE-EARTH ELEMENTS OF THE CERIUM GROUP. Baturina, E. A.; Luk'yanychev, Yu. A.; Malyuchkov, O. T. (Inst. of Steel and Alloys, Moscow). Soviet Phys.-Solid State (Engl. Transl.), 7: 1527-8(Dec. 1965).

Translated from Fiz. Tverd. Tela, 7: 1892-4(June 1965).

The nuclear magnetic resonance of ^{19}F in the trifluorides of Ce, La, Nd, and Pr was investigated. The second moments were calculated (both theoretically and from the ^{19}F absorption lines) for all four compounds at low temperatures and at room temperature. The differences in the NMR spectra of the fluorides, which have the same type of

lattice and nearly the same parameters, were attributed to their differing magnetic properties. (G.O.Y.)

10264 ELECTRON PARAMAGNETIC RESONANCE OF ERBIUM AND DYSPROSIUM IN CUBIC CRYSTALS. **Chang, I-cheng. Stanford, Calif., Stanford Univ., 1965.** 142p.

It has been proposed that some rare earth ions in cubic crystal fields will have a ground state that belongs to the Γ_8 representation of the cubic group. In order to investigate these Γ_8 quartets, electron paramagnetic resonance of rare earth ions in selected cubic crystals was studied. The theory of EPR for Γ_8 quartets was developed using an effective hamiltonian. Numerical calculations were made. The results suggested that erbium and dysprosium in cubic crystals were potential candidates for Γ_8 masers. Electron paramagnetic resonance measurements were made for Er^{3+} in MgO, CaO and SrO crystals and Dy^{3+} in CaF_2 and SrF_2 crystals. For all these crystals Γ_8 quartets were observed. The corresponding crystalline field parameters were determined. The results could be explained by a "modified" point charge model. Measurements of spin-lattice relaxation time were made for Er^{3+} in CaO. The results checked qualitatively with theoretical calculations. It was determined that, considering the present status of crystal-growing technology, the chance of a Γ_8 maser is not promising. The main reasons are: (i) the presence of various axial field spectra due to charge compensation processes, and (ii) line broadening due to crystal imperfections. (Dissertation Abstr.)

10265 STABILITY OF MAGNETIC MOMENTS UNDER PRESSURE IN RARE-EARTH METALS. **Blandin, A.; Coqblin, B.; Friedel, J. (Univ. Paris, Orsay, France). 16p. (CONF-650423-6). ORINS. Gmelin, AED-CONF-65-058-15.**

From International Conference on Physics of Solids and High Pressures, Tucson, Ariz.

In most cases, rare earth metals can be described by an ionic model. But cerium, europium, and ytterbium are exceptions. The peculiarities of these rare earths can be seen in macroscopic constants, such as the atomic radius, thermal expansion coefficients and compressibilities, valency, and magnetic moments. Clearly the strange behavior of these three rare earths seems to be related to a nearly empty or full f shell in cerium and ytterbium respectively, and a nearly full spin-up shell in europium. It is known from the atomic data and chemical considerations that a configuration $4f^n5d^16s^2$ has an energy close to $5d^26s^2$ or $5d^16p^16s^2$, in the case of cerium, and similarly for europium and ytterbium. The theoretical model used to explain the general features of the series is an extension of the virtual bound state model or localized magnetic states model of Anderson and Friedel. The approach of Anderson is used for the discussion, but the results can be derived by the scattering formalism. (J.F.P.)

REACTOR TECHNOLOGY

General

Refer also to abstracts 9054, 9097, and 9382.

10266 (APDA–178) QUARTERLY TECHNICAL PROGRESS REPORT ON AEC-SPONSORED ACTIVITIES, JULY–SEPTEMBER 1965. (Atomic Power Development Associates, Inc., Detroit, Mich.). Contract AT(11-1)-865. 75p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

Separate abstracts were prepared for 6 of the included sections. Brief sketches of research progress on fast reactor fuel meltdown studies and a compilation of Fermi experience are also included. (M.O.W.)

For abstracts of individual sections see: 8816, 9120, 10267, 10285, 10366, and 10423.

10267 (APDA–178, pp 43-9) FUEL ELEMENT FLOW STABILITY STUDIES. Edwards, J. J. (Atomic Power Development Associates, Inc., Detroit, Mich.).

Testing to determine static pressure distributions within the simulated fuel rod bundles as a function of flow rate was completed for rod bundles with 6-, 18-, and 36-inch-wire wrapped pitch, and 0.250-inch-diameter wires. Tubes simulating creep-induced deformations between support planes were also introduced into the tube array, and the resulting pressure distributions measured. Data from the bundles tested were processed into a more convenient form for analysis using a specially written data reduction code, and a thorough examination of a large volume of data was initiated. (M.O.W.)

10268 (BNWL–147) SWISSCHEESE: A 7090 FORTRAN IV CODE FOR THERMAL-HYDRAULIC ANALYSIS OF GAS-COOLED NUCLEAR REACTORS. Leach, C. E. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Oct. 1965. Contract AT(45-1)-1830. 87p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

The computer program SWISSCHEESE developed for the analysis of fluid flow and heat transfer in gas-cooled axial-flow reactors is described. The reactors are taken to be right-circular cylinders pierced by an arbitrary number of coolant passages. (D.C.W.)

10269 (BNWL–174) UNDERWATER REFURBISHING OF FUEL ELEMENTS. Allen, C. H.; Sharp, R. E. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Dec. 1965. Contract AT(45-1)-1830. 17p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Tools and procedures were developed to make underwater repairs to wire wraps and metal bands for fuel elements. Substantial cost savings have been realized, and new applications have been discovered relative to underwater removal and replacement of fuel rods in the fuel cluster and assembly and disassembly of segmented fuel rods. (auth)

10270 (EUR–2547.e) METHOD TO PREDICT THE MASS FLOW DENSITY DISTRIBUTION THROUGH A WATER COOLED REACTOR CORE. de Bruin, C.; de Heer, C. D.; Dekker, N. H. (Reactor Centrum Nederland, The Hague). 1965. 56p. Dep. mn.

Since in watercooled reactor cores the radial power distribution is non-uniform, there is a possibility that in some of the hot channels boiling (saturated and/or subcooled boiling) may occur. This phenomenon leads to two-phase-flow in the boiling channels which results in a flow depression. From this consideration it can be seen that in general a nonuniform power distribution may cause a nonuniform massflow density distribution. A method was developed to evaluate this massflow density distribution. (auth)

10271 (GA–6635) REVISED GAD—AN INFINITE MEDIUM DEPLETION PROGRAM FOR REACTOR FUEL CYCLE ANALYSIS. Todt, F. W. (General Atomic, San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science). Nov. 10, 1965. Contract AT(04-3)-167. 140p. Dep. mn. CFSTI $4.00 cy, $1.00 mn.

The computer program REVISED GAD is described with which the burnup of up to twelve discrete fuel compositions (regions or stages of irradiation) may be followed simultaneously. (D.C.W.)

10272 (NAA-SR–9339) AEC UNCLASSIFIED PROGRAMS. Quarterly Technical Progress Report, October-December 1963. (Atomics International, Canoga Park, Calif.). Nov. 15, 1965. Contract AT(11-1)-Gen-8. 248p. Dep. mn; CFSTI $3.00 cy, $1.25 mn.

Progress is reported on: the development of sodium-cooled power reactors; development of organic-cooled and -moderated reactors; Hallam Power Reactor research and development activities; reactor safety investigations; separations chemistry for reactor fuels and coolants; general reactor physics studies; and physical chemistry of inorganics. (T.F.H.)

10273 (NAA-SR–11650) QUARTERLY TECHNICAL PROGRESS REPORT, AEC UNCLASSIFIED PROGRAMS, JULY–SEPTEMBER 1965. (Atomics International, Canoga Park, Calif.). Dec. 22, 1965. Contract AT-11-1-GEN-8. 206p. Dep. mn. CFSTI $6.00 cy, $1.25 mn.

Separate abstracts were prepared for the 5 included sections. (M.O.W.)

For abstracts of individual sections see: 9379, 10274, 10275, 10375, and 10376.

10274 (NAA-SR–11650, Sect. 1) FAST-REACTOR DEVELOPMENT. (Atomics International, Canoga Park, Calif.). 54p.

Results are presented for various aspects of the fast reactor development program. Included are criticality studies, boiling studies for reactor safety, fuel element transient heating and accident dynamics, carbide fuel material development, carbide fuel element development, cladding evaluation, irradiation testing, and fuel irradiation. (M.O.W.)

10275 (NAA-SR–11650, Sect. 5) NUCLEAR SAFETY AND PHYSICAL RESEARCH. (Atomics International, Canoga Park, Calif.). 47p.

Results of measurements of the effective resonance integral and Doppler effect in gold are presented. A discussion of fission product retention by reactor coolants is presented. Properties of sodium fires and fission product release are discussed in some detail. Brief summaries of research in high temperature chemistry, i.e., study of fused salts and metal-metal salt solutions, are presented. (M.O.W.)

10276 (NP–15580) DOCUMENTATION ATTACHED TO EIGHTH GENERAL REPORT ON THE ACTIVITIES OF THE COMMUNITY, MARCH 1964–FEBRUARY 1965. (European Atomic Energy Community). Mar. 1965. 248p. Dep. mn.

Separate discussions of activities carried out by the European Atomic Energy Communities are presented. The discussions included are: the cost of nuclear electricity, proven-type reactors, heavy-water and organic-liquid reactors, homogeneous reactors, fog-cooled reactors, advanced gas reactors, fast neutron reactors, controlled thermonuclear reactions, reprocessing and transportation of irradiated fuels, labeled molecules and radioisotopes, industrial applications of radioisotopes and radiation, nuclear marine propulsion, materials testing reactors, plutonium and transplutonium elements, CNMB nuclear measurements, reactor physics, and other miscellaneous research. (M.O.W.)

10277 PEBBLE BED REACTOR STUDY FLOW VISUALISATION EXPERIMENT. Gleed, D. B.; Leesment, H. H. At. Energy Austral., 8: 14-16(Oct. 1965).

The flow visualization experiment is described for studying the nature of the flow of fuel balls in pebble bed reactors. The bed is seeded with balls containing cobalt 60 and externally mounted scintillation detectors track the

movement of the labeled balls through the bed. Photographs of the ball flow profiles are shown, and the general observations are discussed. (L.B.S.)

10278 OPERATION, CONSTRUCTION, AND DEVELOPMENT OF NUCLEAR REACTORS IN THE GERMAN FEDERAL REPUBLIC. Kuehne, Hans. Energiewirtsch. Tagesfrag., 14: 397-402(Sept. 1964). (In German).

The reactors in operation, under construction, and in the planning stage in the Federal Republic are discussed and tabulated. An indication of the long-range program with respect to fast breeders and thermal thorium convertors is given. (J.S.R.)

10279 HEAT TRANSFER IN LIQUIDS IN NUCLEAR REACTORS. Mondin, H. Genie Chim., 90: 96-101 (Oct. 1963). (In French).

Methods for obtaining the specific maximum power, especially of high-flux research reactors and power reactors, are considered. Heat transfer in a reactor channel is described using equations for capacity and transport. Single-phase coolants are discussed. Transfer coefficients for forced convection are illustrated, and data for flux values, exchange coefficients, and specific powers of typical one-phase-coolant reactors are tabulated. Two-phase reactors are examined for determining heat transfer limits. Methods for increasing the critical flux are considered, including addition of volatile materials, acceleration, and spray cooling. Heat transfer by a gas-liquid mixture with negligible vaporization is plotted. (TCO)

10280 A PHOTOELASTIC INVESTIGATION OF LIGAMENT STRESSES IN A FLAT PLATE WITH AN ARRAY OF REINFORCED OPENINGS. Money, H. A. (Berkeley Nuclear Labs., Eng.). J. Brit. Nucl. Energy Soc., 4: 308-13(Oct. 1965).

The stresses between an array of nozzles were investigated with specific consideration of the dependence of ligament stresses on the nozzle thickness. It was concluded that to prevent gross yielding at test pressure, a nozzle should be sufficiently stiff to approximate a neutral hole. In a square array, the shielding effects of adjacent nozzles change the loading conditions so that the minimum stress concentration factor occurs with a thinner nozzle than in an infinite field. (D.C.W.)

10281 AN ANALOGUE SIMULATOR FOR THE SOLUTION OF PROBLEMS INVOLVING TRANSIENT HEAT CONDUCTION. Crisp, R. J. (Berkeley Nuclear Labs., Eng.). J. Brit. Nucl. Energy Soc., 4: 314-18(Oct. 1965).

An analog simulator developed for the investigation of steady-state and transient temperature distributions in reactor components is described. The theory of the electrical-thermal analogy is outlined, and an application of the simulator to an investigation of the temperature changes and thermal stresses experienced by a magnox-uranium fuel element during charging into the reactor is discussed. (D.C.W.)

10282 COSTS, ECONOMY, AND FUTURE DEVELOPMENT OF NUCLEAR ENERGY IN THE COMMUNITY. Michaelis, Hans. Neue Tech., 5: 199-211(1965). (In German).

The economic basis of energy production and the development of an electrical industry in the European Atomic Energy Community is summarized. Nuclear power plants in the Community are discussed. The cost and future cost development of nuclear power plants of tested types are considered. The possible development of nuclear capacity and of nuclear energy production in the Community is discussed. The supplies of nuclear fuel elements are also discussed. The development of advanced convertors and of fast breeder reactors is reviewed. The problem of plutonium economy is also considered. The advantages of the Community program and the industrial requirements are indicated. (J.S.R.)

10283 THE POLITICS OF NUCLEAR FUEL SUPPLY IN THE COMMUNITY. Spaak, F. Neue Tech., 5: 217-23(1965). (In German).

The present and future situation with respect to the market for nuclear fuels in the European Atomic Energy Community and in the free world is discussed with respect to natural uranium, enriched uranium, and plutonium. It was concluded that the Community should assure the supply under the best possible conditions and under maximum conditions of security and should assure non-discrimination among the users. (J.S.R.)

10284 AN ASSESSMENT OF REACTOR SAFETY MODELLING TECHNIQUES BASED ON THE ACCIDENT TO THE SL-1 BOILING WATER REACTOR. Warren, G. R.; Rice, T. W. (United Kingdom Atomic Energy Authority, Foulness Island, Eng.). Nucl. Struct. Eng., 2: 490-3(Nov.-Dec. 1965).

Scale model tests carried out in order to find the effect of rapid changes in pressure on water filled pressure vessels are described. Electrically exploded foils are used to simulate the time scale of a destructive nuclear excursion in a water moderated reactor. The SL-1 reactor accident gave the opportunity to see whether the modeling techniques can be used with confidence. The results obtained from a relevant model test proved to be in close accordance with the full scale effects found during the SL-1 accident. (auth)

Auxiliaries and Components

10285 (APDA-178, pp 18-29) SMALL LEAK SODIUM-WATER REACTION. Muenchow, H. O. (Atomic Power Development Associates, Inc., Detroit, Mich.).

A test loop was constructed in which a series of tests will be made to establish a means of estimating the extent of tube wastage in a sodium heated steam generator during a small leak of water into sodium and to determine the dominant parameters of tube wastage during a small water leak so that these parameters may be taken into account in the design of a unit. The test loop is described. (M.O.W.)

10286 (APDA-180) ATTENUATION MEASUREMENTS OF SOUND AND PERFORMANCE OF ULTRASONIC TRANSDUCERS IN 600 F LIQUID SODIUM. Ying, Shuh-Pan; Scott, Clyde C. (Atomic Power Development Associates, Inc., Detroit, Mich.). Dec. 15, 1965. Contract AT(11-1)-865. 28p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Tests were conducted to define the attenuation of sound waves in liquid sodium and to provide information necessary to the development of concepts for general-purpose under sodium scanning systems. During the testing period, three peizoelectric materials, x-cut quartz, lead metaniobate, and lead zirconate-titanate, were used. Of the three materials, the lead zirconate-titanate performed better at 600°F than either the quartz or the lead metaniobate. The ultrasonic transducers were found to work satisfactorily in liquid sodium at temperatures to and including 600°F. The ultrasonic attenuation and the velocity of sound in liquid sodium (99.95% pure) were measured in the temperature range from 220°F to 600°F, and the experimental results were investigated with regard to the theory on relaxation in liquid. Conceptual designs of two practical methods for viewing objects immersed in liquid sodium, the single transducer scanner and the electronic acoustic image conversion system, are summarized. (auth)

10287 (BNWL-SA-179) ADDITIONAL CRACK PROPAGATION TESTS ON ZIRCALOY-2 REACTOR PRESSURE TUBES. Aungst, R. C. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Sept. 20, 1965. Contract AT(45-1)-1830. 30p. (CONF-651017-3). Dep. mn; CFSTI $2.00 cy, $0.50 mn.

From Electrochemical Society Meeting, Buffalo.

A reproducible drop-weight test was developed to test the nil ductility transformation temperature of Zircaloy-2 pressure tubing using specimens cut from the tube wall. Results of fracture tests on slotted tube specimens covering a wide range of temperatures were used to construct a fracture analysis diagram. A discussion of the test results is presented. (M.O.W.)

10288 (CEA-R-2784) LA DETECTION DES RUPTURES DE GAINE DANS LES PILES NUCLEAIRES REFROIDIES PAR GAZ [THESES]. (Can-Rupture Detection in Gas-Cooled Nuclear Reactors [Thesis]). Roguin, Andre (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1965. 159p. Dep. mn.

Submitted to Paris Univ., France.

Can-rupture detection is one important aspect of pile safety, more particularly so in the case of gas-cooled reactors. A rapid and sure detection constitutes also an improvement as far as the efficiency of electricity-producing nuclear power stations are concerned. Among the numerous can-rupture detection methods, that based on the measurement of the concentration of short-lived fission gases in the heat-carrying fluid has proved to be the most sensitive and the most rapid. A systematic study of detectors based on the electrostatic collection of the daughter products of fission gases was undertaken with a view to equiping the reactors EL-2, G-3, EDF-1, EDF-2, and EDF-3, the gas loops of PEGASE and EL-4. The different parameters are studied in detail in order to obtain a maximum sensitivity and to make it possible to construct detection devices having the maximum operational reliability and requiring the minimum maintenance. The primary applications of these devices are examined in the case of the above-mentioned reactors. (auth)

10289 (CONF-650620, pp 166-77) SODIUM COMPONENT TEST INSTALLATION. Leppard, J. A. (Atomics International, Canoga Park, Calif.).

The Sodium Component Test Installation is a large liquid metal system designed specifically for the developmental and proof testing of the prototype sodium-headed steam generators. The plant is described and the activities of the past year and future programs are reviewed. (W.L.G.)

10290 (CONF-650620, pp 244-54) ESADA SODIUM-WATER REACTION TESTS. Douglas, R. E. (Atomics International, Canoga Park, Calif.).

The test facility for studying the sodium–water reaction resulting from a ruptured tube in a modular steam generator is described. (W.L.G.)

10291 (GEAP-4967) RADIAL VANE STEAM SEPARATOR DEVELOPMENT. Quarterly Report No. 5, July–September 1965. Moen, R. H. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). Oct. 1965. Contract AT(04-3)-189. 57p. (EURAEC-1533). Dep. mn. CFSTI $3.00 cy, $0.50 mn.

Work Performed under United States–Euratom Joint Research and Development Program.

Tests of the model full circle radial vane separator were carried out using a complete circle (48) of 6-inch and 12-inch nozzles, in addition to tests using twenty-four 12-inch and twenty-four 18-inch nozzles. These tests show that the separator operates with acceptable carryover and carryunder at about design conditions. This indicates that the flow of air off the ends of the vanes with the water may not be too troublesome a problem. The Large Air-Water Test Facility was used for the above tests which demonstrated the successful completion of the modification to this facility required to permit testing. Test results are included. (auth)

10292 ARE NUCLEAR POWER PLANTS SAFE? Weckesser, August. Energiewirtsch. Tagesfrag., 14: 406-7(Sept. 1964). (In German).

The principal safety devices of nuclear reactors are briefly summarized to show that even in an extremely pessimistic assumption of an improbable accident the vicinity is not endangered. (J.S.R.)

10293 TRENDS IN NUCLEAR COMPONENTS AND MATERIALS. PART I. EuroNuclear, 2: 530-2(Nov. 1965).

The design and development of some conventional components used in nuclear reactors and similar projects are discussed. Pumps, blowers, and molten metal pumps are described. (M.C.G.)

10294 A PLUG OR CLOSURE ELEMENT. Thome, Paul (to Commissariat a l'Energie Atomique). British Patent 1,010,124. Nov. 17, 1965. Priority date Jan. 11, 1963, France.

A plug or closure element for use with a nuclear irradiation capsule comprises a body provided with a flange or other means for securing the plug in an aperture of the capsule. The body is formed with a cylindrical passage extending through it from end to end to receive thermocouple leads. A transverse bore intersects the passage so that soldering material can be introduced through the bore for securing the leads to the body. The body also includes at each end means for supporting the leads against transverse forces so that such forces will not be transmitted to the leads in the region of the soldered joint between the leads and the body. (B.L.M.)

10295 IMPROVEMENTS IN OR RELATING TO BUILDINGS SUITABLE FOR HOUSING NUCLEAR REACTOR INSTALLATIONS. (to Siemens-Schuckertwerke Aktiengesellschaft). British Patent 1,010,180. Nov. 17, 1965. Priority date Mar. 20, 1963, Germany.

A building suitable for housing a nuclear reactor installation comprises a hollow, rotationally symmetrical body having a horizontal or substantially horizontal axis of revolution and an arcuate generatrix that does not cut the axis. The body has a greater extent at right angles to the axis between the opposed ends of the body that are on the axis than it has at the ends. The entrance or entrances are axially positioned at the end or ends. Substantially the lower half of the building is below ground, and the building is formed of ferro-concrete with a gas-tight lining at its inner side. The body is prestressed in an angular direction with the stressing elements arranged in tubular elements embedded in the concrete and anchored against the set concrete after the stress is applied. (B.L.M.)

10296 IMPROVEMENTS RELATING TO NUCLEAR REACTORS. Webb, John (to United Kingdom Atomic Energy Authority). British Patent 1,010,653. Nov. 24, 1965. Filed Feb. 21, 1961.

A replacement shield plug interchangeable with a normal shield plug is provided for reactors of the kind in which fuel elements in the core are accessible through at least one hole penetrating the radiation shielding enclosing the core. During a fuelling or unloading operation, the shielding plug that normally closes the hole penetrating the shielding is replaced with the interchangeable plug, which includes means for reaching out and grasping objects such as fuel elements on the core side of the shield plug. Both operations are controllable by direct manipulation at the face of the shield plug on the outside of the radiation shield. (B.L.M.)

10297 ARRANGEMENT FOR CONTROLLING AN ESCAPE OF PRESSURIZED FLUID FROM A NUCLEAR REACTOR. (to Westinghouse Electric Corp.). British Patent 1,011,137. Nov. 24, 1965. Priority date Apr. 6, 1962, United States.

An arrangement is provided for controlling the inadvertent escape of pressurized fluid due to an accident in a pressurized nuclear reactor system disposed in an inner container. A sealed outer container surrounds the inner container to form an annular chamber between the two containers. The annular chamber comprises a vapor space in the lower portion and a liquid chamber above the vapor space. A pool of liquid partially fills the liquid chamber and forms a plenum chamber above the pool. Means are provided for discharging fluid from the upper portion of the inner container directly into the lower portion of the pool to effect condensing and/or absorbing of at least part of the vaporized portion of the fluid by the pool. Conduit means extend through the pool and couple the plenum chamber to the vapor space to conduct uncondensed vapors from the plenum chamber to the vapor space. (B.L.M.)

10298 IMPROVEMENTS IN AND RELATING TO A CORE STRUCTURE FOR A NUCLEAR REACTOR. Boutin, Claude; Lemesle, Georges; Foglia, Sebastien; Rouge, Pierre; Martin, Roger (to Commissariat a l'Energie

Atomique). British Patent 1,011,338. Nov. 24, 1965. Priority date Mar. 27, 1962, France.

A core structure for a nuclear reactor includes columns of solid moderator material with their axes parallel to a common direction. The columns are maintained in their initial relation and parallel to the common direction by keying means. The structure also includes channels parallel with the columns and located between the columns for receiving nuclear fuel elements. The pitch of the channel lattice is greater than the pitch of the column lattice. (B.L.M.)

10299 FUEL ELEMENT CENTERING DEVICE FOR NUCLEAR REACTORS. Boudouresque, Bernard; Rouge, Pierre (to Commissariat a l'Energie Atomique). British Patent 1,011,339. Nov. 24, 1965. Priority date Apr. 20, 1962, France.

A device is provided for guiding herring-bone finned canned rod fuel elements into central alignment along the axis of the fuel channel. The device includes at least three axially spaced spiders each having at least three centering blades spaced at equal angular intervals. An end of each blade is located between two successive fins series and is adapted to transmit forces between the structure and the fuel can. The centering device is simple, neither perturbs the coolant flow induced by the fins, nor has a neutron-absorption capacity that is undesirably high. (B.L.M.)

10300 PRESTRESSED CONCRETE PRESSURE VESSEL. Bellier, Jean (to Commissariat a l'Energie Atomique). British Patent 1,012,262. Dec. 8, 1965. Priority date May 8, 1963, France.

A prestressed concrete pressure vessel for a nuclear reactor is made up of a cylindrical shell, a metal lining, and two end caps retained against the shell by longitudinal cables. The cylindrical shell is made up of an outer zone of active concrete that is transversed by the circumferential prestressing cables and an inner or passive zone that is subdivided by longitudinal and circumferential slots into a number of plugs. The inner zone of the concrete shell provides heat insulation for the concrete of the outer zone and is adapted to transfer to the outer zone the pressure forces exerted by the reactor coolant on the metal lining. A heat removal circuit is provided at the boundary of the two concrete zones of the cylindrical shell. (B.L.M.)

10301 DEFORMABLE SEALING JOINT BETWEEN THE CYLINDRICAL PART AND AN END OF THE CAISSON OF A NUCLEAR REACTOR. Bussi, Jean (to Commissariat a l'Energie Atomique). British Patent 1,012,263. Dec. 8, 1965. Priority date May 8, 1963, France.

A sealing joint that is particularly suitable for use between the two parts of a reactor pressure vessel is made up of at least two hollow members which do not need a cooling circuit. The first member is disposed between the two parts to be joined and has a wall whose edges define a first elongated aperture. A second hollow member is disposed within the first and has a wall whose edges define a second elongated aperture aligned with the first. There is a space between the walls of the members, and the edges of the walls of the members on respective sides of the apertures are defined by the first and second aligned apertures being sealed to each other and to a respective one of the parts. A sealing gasket is received between the parts radially outwardly of the members. (B.L.M.)

10302 IMPROVEMENTS IN NUCLEAR REACTORS. Deighton, Thomas (to Babcock and Wilcox Ltd.). British Patent 1,012,433. Dec. 8, 1965. Filed Mar. 10, 1961.

A fluid cooled reactor has fuel elements positioned by end locating means, one of which includes an abutment adapted to slowly yield when subjected to pressure exerted by the fuel element through the adjacent end but quickly to follow retraction of the end. The abutment is in the form of a hydraulic unit including fixed and movable members defining a liquid-filled space. The liquid can slowly leak from the liquid-filled space and quickly return through a non-return valve during retraction of the abutment. (B.L.M.)

10303 METHOD OF MOUNTING TUBES IN NUCLEAR REACTOR CORES. Bridoux, Claude; Foulquier, Henri; Stohr, Jacques A.; Thome, Paul (to Commissariat a l'Energie Atomique). Canadian Patent 718,604. Sept. 28, 1965. Priority date Mar. 1, 1960, France.

To allow replacement of a defective tube after the reactor is put into service, the tubes are formed as prefabricated elements. One end contains a sleeve that can be welded directly to the envelope of the reactor core. Complementary threads provided on the two portions to be joined give a fluid tight seal. Details of fabrication and precautions necessary to fulfill conditions required by thermal expansion and sealing against leakage are described. (F.S.A.)

10304 DUMP PORTS FOR VESSELS. Beynon, Charles E.; Wilson, Ivan L.; Siddall, Ernest (to Atomic Energy of Canada Ltd.). Canadian Patent 720,143. Oct. 19, 1965. Priority date Jan. 11, 1962, United States.

An improved form of dump port intended for rapidly draining the heavy water moderator from a nuclear reactor is described and illustrated. In normal operation the heavy water is held in the calandria by gas pressure from below. On removal of this pressure it is desirable to have the heavy water drain into the space below in as short a time as possible. A series of U shaped tubes having two slightly constricted portions reduce turbulence to a minimum thus permitting rapid dumping of the moderator liquid. (F.S.A.)

10305 DRIVE FOR A REACTOR CONTROL ROD. Sasaki, Seisho (to Hitachi, Ltd.). Japanese Patent 1964-12694. July 6, 1964. Filed Nov. 17, 1961.

An emergency shutdown drive mechanism for a control rod is proposed. The mechanism consists of a threaded bar movable with the shaft of a drum from which the control rod is suspended by means of a rope; a nut movable in the direction of the shaft axis by means of a screw nut mechanism on the threaded bar; a compression spring for forcing the nut in the direction of the shaft axis; and a device capable of adjusting the accelerating force, operating time, damping, etc. (TCO)

10306 REACTOR PRESSURE VESSEL WITH REDUCED SECONDARY STRESSES. Hamada, Kunio (to Hitachi Ltd.). Japanese Patent 1964-15090. July 30, 1964. Filed Dec. 14, 1961.

A reactor pressure vessel constructed with a curved bottom plate and cylindrical body with considerably reduced secondary stresses is proposed. A material with a larger thermal expansion coefficient than the bottom-plate material is welded along the periphery of the junction of the plate and body. This joint tends to expand the bottom plate by the larger thermal expansion coefficient; thus secondary stresses in the vessel walls are reduced to a minimum with the design limitations being largely eliminated. (NSA of Japan)

10307 PERIOD METER. Okamura, Michio (to Japan Atomic Industries, Ltd.). Japanese Patent 1964-16147. Aug. 8, 1964. Filed Mar. 31, 1962.

A period meter is described that measures the reactor period without differentiating the output signal. The period meter consists of the following components: a detector for detecting the output from the reactor; at least one amplifying and shaping circuit, such as a flip-flop, for amplifying and shaping the output pulses from the detector; a first and second pumping circuit, each of which consists of a capacitance and resistance connected in parallel, and a period indicator. The capacitance of the first pumping circuit is energized by the output signal from the amplifying and shaping circuit, and the second pumping circuit operates with a delay time or has another time constant with respect to the first pumping circuit. The period indicator is operated by the difference between the output signals from the first and second pumping circuits with the output detected at any moment being compared with that a small time before, and the difference between the two being measured. (NSA of Japan)

10308 A CONTROL ROD FOR A NUCLEAR REACTOR. Nakamura, Shoichiro (to Hitachi, Ltd.). Japanese Patent 1964-16149. Aug. 8, 1964. Filed Apr. 16, 1962.

A control rod is proposed that has excellent controlling power, is simple to fabricate, and is low in production costs. The control rod is characterized in that it is made up of a mixture of an organic resin moderator and the neutron absorber, e.g., boron. The mixture contains 100 parts by weight of an epoxy resin and 15 parts by weight of tetraethylene pentamine mixed uniformly before the neutron absorber is added. The entire mixture is agitated and then poured into a mold to stand for several hours at 70 – 80°C until it solidifies. (TCO)

10309 APPARATUS FOR CHANGING CONTINUOUSLY THE PITCHES OF FUEL RODS IN A REACTOR. Suzuki, Takao (to Mitsubishi Heavy Ind., Ltd.). Japanese Patent 1964-18478. Aug. 31, 1964. Filed Nov. 29, 1961.

The apparatus described permits changing the pitches of fuel rods simply, rapidly, and continuously in a reactor, with no laborious work. Essentially the apparatus consists of a rectangular load-bearing frame with parallel supports and a second rectangular frame with fuel-rod guides also running parallel. When the two frames are rotated, one over the other, and take a given position, the pitches of fuel rods are changed from their former positions. In this way, the ratio of moderator to fuel in the reactor core is changed for the purpose of experiments. The shape of an assembly of fuel rods, to which the apparatus is applicable, is an equilateral triangle, square, etc. (NSA of Japan)

10310 LOGARITHMIC RECORDING TYPE PERIOD METER. Kuwabara, Jun (to Japan Atomic Energy Res. Inst.). Japanese Patent 1964-21415. Sept. 30, 1964. Filed Mar. 27, 1963.

The logarithmic recording-type period meter described is superior in simplicity, reliability, and accuracy to conventional period meters. Most or all of the balancing slide resistance in the automatic balancing meter is provided by the exponential-function-type slide rheostat. The input proportional to the reader output is measured by using the logarithmic scale. The period is determined from the output of a tachometer dynamo directly connected to the balance motor at the scale. (NSA of Japan)

10311 REACTOR PERIOD METER USING A PROPORTIONATING-TYPE COUNTER SYSTEM. Kuwabara, Jun (to Japan Atomic Energy Res. Inst.). Japanese Patent 1964-21416. Sept. 30, 1964. Filed Apr. 11, 1963.

The period meter proposed is superior in simplicity, stability, reliability, and ease in reading to conventional period meters involving logarithmic conversion followed by the differentiation. The period meter uses a ratio meter, in which an electric current proportional to the output of the reactor is sent to one coil and an electric current proportional to the variation of the output of the reactor to the other coil. The period of the reactor is obtained from the declination of the two coils. (NSA of Japan)

10312 CONTROL DEVICE FOR REACTOR CONTROL RODS. Kato, Hiroaki (to Hitachi, Ltd.). Japanese Patent 1964-23447. Oct. 21, 1964. Filed Jan. 19, 1961.

An electrical control device is proposed for a reactor control rod. An electromagnetic clutch holding a control rod can also act as a brake in reactor shutdown at the time of an accident. In the normal operation of a reactor, the control rod is driven upward and downward by means of a wire wound around a drum operated by a motor. In emergency shutdown, the electromagnetic clutch goes off, and the control rod drops by its own weight. When the rod reaches a given position in dropping or after a specified time, the electromagnetic clutch with the control rod is braked by means of a detecting device and application of electric power to the electromagnet. (NSA of Japan)

10313 NUCLEAR REACTOR CLOSURE. Tollet, Louis Henri Joseph (to Societe Anglo-Belge Vulcain). U. S. Patent 3,215,302. Nov. 2, 1965. Priority date Mar. 9, 1961, Belgium.

A cover is provided for a reactor having a cylindrical cavity with a number of vertically-diposed elements protruding upwardly into the cavity and in which the space between the vertical elements is normally filled with a fluid. The closure comprises a flat metal cap larger in diameter than the cavity having a flange extending about the entire periphery of the cavity. A cylindrical metal plug formed as an integral part of the cap and centrally located on the cap extends into the cavity to a point beyond the ends of the elements. A number of vertical bores are formed in the plug having a size and shape to receive the ends of the elements to decrease the space normally filled by fluid and to add mechanical strength to the cover. (B.L.M.)

10314 PROCESS FOR MAKING A LEAD SCREEN. Marchal, Raymond; Chevalier, Roger; Combecave, Michel (to Commissariat a l'Energie Atomique). U. S. Patent 3,216,077. Nov. 9, 1965. Priority date Sept. 10, 1961, France.

A process is described for the manufacture of a lead screen in a light metal casing for limiting the propagation of gamma radiation in the vicinity of a core of a reactor, particularly around the core of a swimming pool reactor. The process consists of providing on the inner face of the casing a thin metallic covering of one or more layers; cleaning the inner face of the covering by fluxing it; and then casting in the lead which is to constitute, inside the casing, the screen itself. Cooling tubes may be provided within the thickness of the lead screen by assembling the tubes within the casing and subjecting the external surface of the tubes to the same treatment as the internal surface of the casing prior to the casting of the lead. (B.L.M.)

10315 NUCLEAR REACTORS. Butler, Graham Frederick; Engleheart, William Paul (to Nuclear Power Plant Co. Ltd.). U. S. Patent 3,219,536. Nov. 23, 1965. Priority date Dec. 7, 1959, Great Britain.

A burst slug detection system for a gas-cooled graphite-moderated reactor comprises means for continuously passing to fission product detection means mixed samples of cooling fluid from each of a series of groups of channels containing fuel elements together with means for passing samples of cooling fluid from each fuel channel of a group in turn. This sampling of individual channels and groups takes place simultaneously. Description of the sampling valve and detection apparatus are given in detail. (B.L.M.)

10316 APPARATUS AND METHOD FOR REMOVING FISSION BY-PRODUCT METAL VAPORS IN GAS COOLED NUCLEAR REACTOR SYSTEM. Glueckauf, Eugen; Flowers, Ronald Henry; Pummery, Frederick Charles William (to United Kingdom Atomic Energy Authority). U. S. Patent 3,219,538. Nov. 23, 1965. Priority date Dec. 20, 1961, Great Britain.

An apparatus for the removal of fission product metals from the coolant gas of a reactor consists of a filter bed located in the hot region of the reactor between the fuel elements and the heat exchanger. The filter bed is made up of discrete particles of glass or slag that have sufficient stability to withstand a temperature of at least 700°C without fusing together and that possesses a sufficiently high diffusion coefficient to allow the absorbed fission products to diffuse into the whole mass of the material. The glass or slag may be in the form of fibers to form a mat or cloth or in discrete particles, viz. as rings, rods, tubes, or beads. A single filter bed may be used that has a capacity to last for a sufficient time until the reactor can be shut down for replacement, or a bed may be provided for each channel or group of channels with provision for shunting the gas flow through different beds so that one bed can be replaced when exhausted. (B.L.M.)

10317 REFLECTORS FOR NUCLEAR REACTORS HAVING REMOVABLE SOLID MODERATOR ELEMENTS. Costes, Didier (to Commissariat a l'Energie Atomique). U. S. Patent 3,219,540. Nov. 23, 1965. Priority date May 17, 1961, France.

In a heterogeneous reactor of the horizontal pressure-tube type, including a tank filled with heavy water liquid moderator, an internal lining is provided for the wall of the tank. The lining consists of removable prismatic canned elements of solid graphite moderator material

extending substantially the length of the tank and covered with a material having a low neutron-absorption capacity. The canned elements are held against the internal surface of the tank by a thin wall, such as a grid, spaced internally from the internal surface of the wall and pervious to the liquid moderator. (B.L.M.)

10318 APPARATUS FOR THE DETECTION OF EXCURSIONS IN A REACTOR. Vincent, Charles Holmes (to United Kingdom Atomic Energy Authority). U. S. Patent 3,219,939. Nov. 23, 1965. Priority date July 29, 1960, Great Britain.

An apparatus is provided for the rapid detection of excursions in a mean pulse-rate, such as occurs in a reactor. A number of pulse ratemeter circuits have their inputs connected to receive the pulses and have output time constants matched to successive values within a range of rates of the excursions desired to be detected. A corresponding number of biasing circuits are provided, one for each diode-pump circuit. Each biasing circuit includes an integrating circuit for further integrating and inverting the output of its associated diode-pump circuit to provide a bias exceeding a fixed level by an amount proportional to the mean pulse rate prior to the excursion. The output of each diode-pump circuit is compared with the output of its associated biasing circuit, and a single discriminator means connected to receive the output of all the comparison means detects when the output of any diode-pump circuit differs from that of its associated biasing circuit by a given amount. (B.L.M.)

10319 TURBOCIRCULATOR. Yampolsky, Jack Seymour (to U. S. Atomic Energy Commission). U. S. Patent 3,221,982. Dec. 7, 1965.

A gas turbocirculator especially adapted to be contained within the pressure vessel of a gas-cooled nuclear reactor is described. The arrangement includes a central casing that houses a rotor with a turbine mounted on an upper portion and a compressor below. A diffusor extends downward from the turbine section and has an outer perforated wall permitting gas flow to adjacent heat exchangers. An inlet duct to the compressor is interleaved through the first diffusor and receives gas flow from the heat exchangers. A second diffusor also extends downward from the compressor for lowering the velocity of the gas without flow separation prior to its return to the reactor core. (AEC)

10320 CRANE DEVICE WITH AN EXTENSIBLE GRIPPER MECHANISM. Henry, J. (to U. S. Atomic Energy Commission). U. S. Patent 3,224,615. Dec. 21, 1965.

An extensible crane device was developed for use in handling nuclear reactor components. Maximum progressive linear movement is provided by the combination of an extension rod with a remotely actuated gripper device within a movable frame, a rack and pinion drive for the extension rod, and a closed loop chain drive to operate both the movable frame and the rack and pinion. (AEC)

Criticality Studies

Refer also to abstract 9225.

10321 (AEET–222) THE INHOUR RELATION AND EFFECTIVE DELAYED NEUTRON FRACTION FOR MIXED LATTICES. Srinivasan, M. (Atomic Energy Establishment, Trombay (India)). 1965. 50p. Dep. mn.

The use of the inhour relation in practice, for the conversion of experimentally measured stable doubling times into absolute reactivity values is considered. The problems that arise when the inhour relation is applied to heterogenous heavy water lattice reactors are considered. The uncertainty in the derived reactivity due to uncertainties in the calculation of some of the constants of the inhour relation were estimated. The advantage to be gained in doing the conversion of doubling times into absolute reactivity units in two steps, i.e., through an intermediate step of a relative reactivity unit, is pointed out. A search is made for a universal relative reactivity-doubling time curve, valid for a wide variety of uranium fueled lattices. It is shown that among the available relative reactivity units the inhour is the best. A new relative reactivity unit named ZERLIN which would give a more universal relative reactivity-doubling time curve, has been proposed and its adoption in practice is strongly recommended. Also included is a simple derivation of the inhour equation starting from first principles. (auth)

10322 (CONF-650620, pp 255-70) SODIUM TECHNOLOGY LOOP EVALUATION OF IN-LINE INSTRUMENTS AND PURIFICATION DEVICES. Hill, Eugene F. (Atomic Power Development Associates, Inc., Detroit, Mich.).

The recent additions to the loop and supporting facilities are described, and the status of the instruments and devices being evaluated in the loop and the supporting chemistry program are discussed. (W.L.G.)

10323 (KR–101) THE FORTRAN VERSION OF THE NEUTRON THERMALIZATION CODE K-7 THERMOS FOR THE CDC-3600 COMPUTER. Stamm'ler, R. J. J. (Institutt for Atomenergi, Kjeller (Norway)). Feb. 1965. 14p. Dep. mn.

The basic properties of the neutron transport and thermalization code K-7 THERMOS are described. This is a multiregion and multigroup code which solves the space and energy dependent integral transport equation in an infinitely long heterogeneous reactor cell with cylindrical symmetry and a reflective, white, or black outer boundary. Three types of moderator are allowed, light and/or heavy water, oxygen, and graphite. The free-gas model is used for oxygen and graphite, while for hydrogen and deuterium the choice is either the free-gas model with effective masses, or the Nelkin model, or an anisotropic version of the latter due to Koppel and Young. The code is provided with a cross section library which makes the input system extremely simple. (auth)

10324 (RFR–174) A SIMPLIFIED TREATMENT OF THE SPECTRUM HARDENING IN A FUEL ROD, CAUSED BY SELECTIVE ABSORPTION. Carlvik, I. (Aktiebolaget Atomenergi, Stockholm (Sweden)). Jan. 30, 1962. 20p. Dep. mn.

The neutron blackness of a fuel rod in a thermal reactor varies with the neutron energy. This causes a hardening of the neutron spectrum in the rod and causes the effective absorption cross section of the fuel to be smaller than the usual average (thermal flux weighted) cross section. Simple approximations are used to show the general features of this effect, and curves are given that show the resulting reduction in the effective absorption cross section both for the fuel and for a thin can surrounding the fuel. The effect on the can is small, 3% of the absorption cross section at most, but the effect on the absorption cross section of the fuel can be considerable. For an 18-mm UO_2 rod (R3 rod), the effect can cause a reduction in the thermal utilization of about 0.5%. (auth)

10325 (RFR–248) DANCOFF-2—A PROGRAM FOR CALCULATING THE DANCOFF FACTOR IN A ROD CLUSTER. Carlvik, I. (Aktiebolaget Atomenergi, Stockholm (Sweden)). Dec. 17, 1963. 32p. Dep. mn.

The computer program DANCOFF-2, which calculates the Dancoff factor for a large number of rod radii and coolant cross sections simultaneously for a certain rod configuration, is described. The program is written in autocode for the Ferranti Mercury. (D.C.W.)

10326 (RFR–265) AN INVESTIGATION OF THE ACCURACY OF SOME APPROXIMATIONS TO THE DANCOFF FACTOR FOR A CLUSTER. Carlvik, I. (Aktiebolaget Atomenergi, Stockholm (Sweden)). Feb. 11, 1964. 28p. Dep. mn.

Three approximate methods for calculating the Dancoff factor for rod clusters were investigated by comparing results with "exact" values. Calculations were carried out for hexagonal 7-rod and 19-rod clusters over the region $x = 0$ to 1.0 and $y = 0.2$ to 0.5, where x is the ratio between cluster pitch and coolant mean free path and y is the ratio between rod radius and pitch. The approximations investi-

gated were those two that have been used in the Burnup program and the Bell approximation. As could be expected the approximations are reasonably good over certain parts of the range of the variables considered and fail in others. The Bell approximation seems to be slightly superior. It is recommended that accurate methods (ERIC, Dancoff-2 programs) be used whenever possible, especially for calculating differential effects such as void coefficients. When a quick method is necessary, the Bell approximation should be preferred. It has also the advantage of employing a very simple analytical expression. (auth)

10327 (RFR-282) DANCOFF-5—A COMPUTER CODE FOR CALCULATING THE DANCOFF FACTOR FOR AN INFINITE RHOMBIC LATTICE OF CIRCULAR CYLINDRICAL RODS. Carlvik, I. (Aktiebolaget Atomenergi, Stockholm (Sweden)). June 15, 1964. 20p. Dep. mn

The computer program Dancoff-5 which calculates the Dancoff factor for an infinite rhombic lattice of cylindrical rods is described. The program is written in autocode for the Feranti Mercury computer. (D.C.W.)

10328 (RFX-70) ECCENTRIC TEST REGIONS IN SUBSTITUTION MEASUREMENTS. Persson, Rolf (Aktiebolaget Atomenergi, Stockholm (Sweden)). May 3, 1961. 8p. Dep. mn.

The theory of an eccentric control rod was used in order to find the radial dependence of the weight function of eccentric test regions. In the case of small changes of the radial buckling we get the weight function proportional to $[J_0(2.405\ r/R)]^{2-a+\delta B_z^2(0)}$, where $\delta B_z^2(0)$ is the change of the axial buckling with the test region in the center and a is a constant (a = 0.60 in the R0). (auth)

10329 (RT/FI(65)24) TERET—UN PROGRAMMA NUMERICO DI TERMALIZZAZIONE ETEROGENEA ED OMOGENEA PER IBM-7094. (TERET—A Numerical Program for Calculating Heterogeneous and Homogeneous Thermalization for IBM-7094). Forti, G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Sept. 1965. 12p. Dep. mn.

A numerical code is described which evaluates average thermal neutron spectra and cross sections in fuel and moderator in cylindrical cells of a nuclear lattice. Disadvantage factors are calculated for each of the 100 velocity groups. Choice of scattering kernel is free. The thermalization integral equation is solved by direct powers method. The validity of theory and numerical method is discussed and comparisons are made with theoretical and experimental results for a wide series of light water lattice. (auth)

10330 (RT/ING(65)13) DYNAMICS AND CONTROL STUDIES FOR A STEAM-GENERATING PRESSURE-TUBE REACTOR. Giordano, P.; Mathis, A.; Melucci, G. (Comitato Nazionale per l'Energia Nuclear, Rome (Italy)). Sept. 1965. 37p. Dep. mn.

The reactor considered is moderated by heavy water and cooled by two-phase light water mixture, mainly in dispersed flow; the separated steam is sent directly to the turbogenerator. Owing to the predominant neutron absorbing role of the light water, the reactor is affected by a positive coolant void effect on reactivity, which may raise stability problems. The overall plant dynamics and the control system general scheme are examined. First a reliable analog model for the whole plant was developed; in particular the models for the sections described by two-phase hydrothermodynamics were evaluated with special attention. The behavior of the uncontrolled plant was examined, mainly on the analog model; same significant results, however, were checked also in analytical way. This work led to the determination of the stability domains, and to the computation of the general static programs for the plant operation, with respect to a broad range in the value of the main core and plant parameters. A general control scheme was developed, which should meet the normal operational requirements for a wide range of core dynamic characteristics. (auth)

10331 (UJV-1412/65) VLIV PRIMESI H_2O NA REAKTIVITU TEZKOVODNIHO REAKTORU S PRIRODNIM URANEM. (Effects of H_2O Addition on the Reactivity of Heavy Water Moderated Reactor Fueled with Natural Uranium). Hron, M. (Ustav Jaderneho Vyzkumu, Ceskoslovenska Akademie Ved, Rez). 1965. 16p. ORAU.

The reactivity effects of H_2O addition into the moderator of a heavy water moderated reactor with natural uranium are investigated. The values for various radii of cylindrical fuel rods and various water-uranium ratios were calculated as a function of light water concentration in the moderator. The maximum values of the buckling which can be attained by addition of H_2O at various parameters of the lattice are discussed. It appears that the reactivity increases only in systems with a low moderator-to-fuel volume ratio in the cell. (auth)

10332 (EURFNR-12F) INVESTIGATION OF THE REACTIVITY COEFFICIENT CONNECTED TO THE SODIUM TEMPERATURE IN BIG FAST REACTORS. Chaumont, Jean-Marie; Martin, Jacques (Commissariat a l'Energie Atomique, Cadarache (France). Centre d'Etudes Nucleaires). Translation of report CEA-R-2555. June 1964. 34p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

Work Performed under United States–Euratom Fast Reactor Exchange Program.

The reactivity of large, sodium-cooled, fast reactors is investigated. Separate discussions are presented on the components of the reactivity coefficient connected to the sodium temperature, influence of fuel percentage in the reactor, influence of reactor geometry, influence of sodium cross sections, improvement of the coolant temperature coefficient, and a comparison between experimental and theoretical values of the reactivity coefficient of sodium is presented. (M.O.W.)

10333 MEASUREMENT OF THERMAL UTILIZATION FACTOR IN A SQUARE CELL OF UO_2-H_2O LATTICE. Kobayashi, Keisuke (Kyoto Univ.); Fukao, Masayuki; Matsuura, Shojiro; Ueda, Makoto. J. Nucl. Sci. Technol. (Tokyo), 2: 438-44(Nov. 1965).

The thermal-neutron flux distribution in a square lattice of water-moderated, slightly enriched UO_2 was measured using dysprosium microfoils. The disadvantage factor and the thermal utilization factors were obtained from the data. The experimental results were compared with the results of some approximate calculations. (D.C.W.)

10334 OPTIMAL REFLECTORS TO ACHIEVE CRITICALITY. Tierney, Martin S.; Waltman, Paul (Sandia Lab., Albuquerque, N. Mex.). Nucl. Sci. Eng., 24: 42-8 (Jan. 1966).

Within the framework of a simplified one-dimensional model, the following problem is considered. Given a segment of some fissionable material with a length less than its natural critical length, construct, if possible, reflectors that provide albedos sufficient to make the segment critical (or achieve a prescribed degree of supercriticality) and do this in an optimal way (i.e., with minimum weight or cost). It is shown via asymptotic solutions to the one-dimensional Boltzmann equations that the appropriate left and right albedos lie on a segment of a hyperbola. For any pair of these albedos and for a wide class of optimization criteria, the optimal reflectors can be designed using the technique of dynamic programming. The solution to the problem is then found by a simple minimization along an arc of the hyperbola which relates the left and right albedos. Numerical examples are provided to illustrate the method when the optimization criterion is minimum weight. (auth)

10335 REACTOR-KINETICS STABILITY CRITERIA. Lellouche, Gerald S. (Brookhaven National Lab., Upton, N. Y.). Nucl. Sci. Eng., 24: 72-6(Jan. 1966). (BNL-9185).

It is shown that it is possible to recast the usual canonical conditions for predicting stability-in-the-large for reactor-kinetics systems into terms of the parameters characteristic of the physical system, thus permitting direct qualitative examination of the stability of a given system. For systems with more than one reactivity coefficient, it is found as a direct consequence of the physical formulation that if the prompt coefficient is negative then a delayed positive coefficient can be more stabilizing than a delayed negative coefficient. (auth)

10336 APPLICATION OF DYNAMIC PROGRAMMING TO OPTIMAL SHUTDOWN CONTROL. Ash, M. (Systems Development Corp., Santa Monica, Calif.). Nucl. Sci. Eng., 24: 77-86(Jan. 1966).

The digital computer algorithm produced by the methods of dynamic programming, generates optimal reactor-shutdown programs that (i) minimize the post-shutdown xenon concentration maximum, or that (ii) minimize the xenon concentration itself at a given post-shutdown time. Such shutdown programs are found to consist of pulsing the reactor at specified intervals. The number and duration of the pulses depend on the parameters involved, especially the magnitude of the flux constraints, and the constraints on the xenon override reactivity available in a given fuel loading. (auth)

10337 LOCAL STABILITY IN REACTORS WITH A LINEAR FEEDBACK. Akcasu, A. Ziya (Univ. of Michigan, Ann Arbor). Nucl. Sci. Eng., 24: 88-9(Jan. 1966).

An attempt is made to establish criteria for the local stability that can be applied to reactors operated below their critical power level. An upper bound is found for the initial power disturbances and the subsequent power variations that are asymptotically stable. (L.B.S.)

10338 ON THE VARIATION OF THE Lu:Dy ACTIVATION RATIO IN REACTOR CELLS. Smit, J.; Stamm'ler, R. J. J. (Institutt for Atomenergi, Kjeller, Norway). Nucl. Sci. Eng., 24: 90-2(Jan. 1966).

A foil technique is outlined that measures the spatial variation of the thermal-neutron spectra in unit cells, using a suitably defined spectrum index. The spectrum index used in the measurements and calculation is defined in terms of the ^{176}Lu:^{164}Dy activation ratio in a lattice cell and in a thermal column. It is also shown that the Koppel-Young energy transfer model, when used in numerical calculations of the THERMOS type, gives satisfactory agreement with measured values of the spectrum in H_2O- and H_2O-D_2O-moderated NORA lattices. (L.B.S.)

10339 DETERMINATION OF RADIAL BUCKLING IN REFLECTED REACTORS. Serdula, K. J. 10p. (CONF-650602-77). ORINS. Gmelin, AED-CONF-65-125-99.

From American Nuclear Society 11th Annual Meeting, Gatlinburg, Tenn.

It is shown that a very accurate radial buckling can be obtained from measurements in a reflected reactor if fluxes are measured with a detector whose neutron sensitivity ratio, that is, fast neutron activation to total activation is high and if the resultant activities are analyzed on the basis of a two-group model. (J.F.P.)

10340 IMPROVEMENTS IN AND RELATING TO NUCLEAR REACTOR PLANTS. (to Sulzer Brothers Ltd.). British Patent 1,012,615. Dec. 8, 1965. Priority date Oct. 30, 1963, Switzerland.

A method is patented for controlling a nuclear reactor plant of the kind that has flowing through it a coolant that receives heat from the reactor as it flows through and gives up the received heat to a load medium in at least one forced-flow once-through vapor generator and in which the temperature of the coolant leaving the reactor is controlled. The method comprises the following steps: adjusting the rate of supply of load medium to the vapor generator in dependence upon at least one vapor temperature when this temperature drops below a desired limit, and adjusting the rate of supply of load medium to the vapor generator in dependence upon the temperature at which the coolant leaves the vapor generator when the temperature exceeds a desired limit. The adjusting means includes two integrating elements, one connected to the vapor temperature detector and the other to a limit-adjusting element. Each integrating element is also connected to a limit-adjusting element. (B.L.M.)

Design and Feasibility

10341 UNDERGROUND NUCLEAR REACTOR. (to Deutsche Erdoel-Aktiengesellschaft). British Patent 1,010,454. Nov. 17, 1965. Priority date Aug. 8, 1961, Germany.

A reactor is patented for installation in an underground deposit through a borehole that is somewhat enlarged at the bottom. The reactor is characterized by a reaction chamber enclosing the fissionable material and the moderator and having an outer diameter so as to permit lowering of the reactor through the borehole when in a non-critical condition. An expansible shield surrounds the reaction chamber during the descent and then expands to be received by the enlargement of the bottom of the borehole when the reactor is in position. A control-rod assembly is mounted on the exterior of the reaction chamber and is operatively connected to a temperature and/or pressure responsive element that controls the insertion and withdrawal of the rod assembly. Provision also is made for introducing additional fuel in response to a control signal or at a predetermined time. The heat exchanger is mounted in the borehole above the reactor. Once the reactor is installed, the borehole can be sealed except for a small passage extending from the reactor to the surface. (B.L.M.)

10342 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. (to General Dynamics Corp.). British Patent 1,010,987. Nov. 24, 1965. Priority date Sept. 17, 1963, United States.

Design of a nuclear reactor employing vertical fuel rods and of rod-handling equipment for moving axially the vertical elements into and out of the reactor core is patented. A vertically defined passageway extends through the core of the reactor, and the vertical fuel rods are spaced horizontally from the passageway. The handling device includes a leg, leg means for lowering the leg through the passageway into the core and alongside the rod, and a grappler on the leg for guiding and supporting the lower portion of the rod. The grappler holds the rod in compression rather than tension so that the upper end of the rod is free to be grasped by other means. (B.L.M.)

10343 INTEGRAL NUCLEAR REACTOR. Knights, Herbert Chilvers (to United Kingdom Atomic Energy Authority). British Patent 1,011,639. Dec. 1, 1965. Filed July 25, 1963.

An integral reactor includes a containment vessel enclosing the pressure vessel and having a sealable opening through which the pressure vessel can be withdrawn as a unit. Inlet and outlet manifolds outside the pressure vessel connect with the heat exchanger inside the pressure vessel, and inlet and outlet pipes penetrate the pressure vessel. Breakable connections are provided between the inlet and outlet manifolds and the inlet and outlet pipes, respectively. The breakable connections are so positioned that after breaking the connections, the manifolds can be withdrawn through the sealable opening with the pressure vessel. (B.L.M.)

10344 IMPROVEMENTS RELATING TO NUCLEAR REACTORS. Ashcroft, David John (to United Kingdom Atomic Energy Authority). British Patent 1,012,572. Dec. 8, 1965. Filed Feb. 8, 1963.

A nuclear reactor is described that employs a primary coolant as an intermediary between fuel elements constituting the reactor core and a secondary coolant. The primary coolant is contained by interconnected tubes, which are clustered in parallel relation and in which elongated fuel elements are received. The tubes are in packs made up of a number of interconnected tubes and removable as a unit independently of the other packs. Each pack has upright inlet and outlet connections extending above the core, and the packs may be interconnected by pipework extending between the inlet and outlet connections. Preferably, the length of the upright connections is such that a sufficient depth of liquid phase secondary coolant to constitute a radiation shield can be interposed between the core and the top ends of the upright connections. (B.L.M.)

10345 LIQUID MODERATOR NUCLEAR REACTORS. Costes, Didier; Lemaitre, Rene (to Commissariat a l'En-

ergie Atomique). U. S. Patent 3,216,902. Nov. 9, 1965. Priority date July 27, 1961, France.

In a liquid moderated reactor having force tubes designed to contain the fuel and for circulating cooling fluid over the cartridges and in which the force tubes are immersed in the liquid moderator provision is made for absorbing the momentary pressure that results from the rupture of one of the force tubes to protect the reactor vessel and structures. A deformable means made up of a number of watertight cushions covers the internal surface of the vessel between the force tubes and the rigid outer wall; and in case of rupture, these deformable means enlarge the space normally occupied by the moderator. The deformable means may be made up of thin sheets of soldered or welded metal or envelopes of plastic material and may be filled with either a gas or a solid absorbent material, which may also act as a moderator for radiation. (B.L.M.)

10346 NUCLEAR REACTORS. Tollet, Louis Henri Joseph (to Societe Anglo-Belge Vulcain). U. S. Patent 3,218,236. Nov. 16, 1965. Priority date May 24, 1961, Belgium.

An apparatus is patented for varying the moderation in a reactor in which a channel defining a moderator space extends through the reactor core and a moderating fluid is contained in the channel. A pair of elongated hollow reciprocable moderator elements of different moderating characteristics than those of the fluid moderator extend throughout the channel. The hollow moderator elements may be filled with moderator fluid, solid moderator masses, or moderator elements containing poison. The elements are longer than the channel by a given distance and vary uniformly and similarly in cross-sectional area along their length, each varying in the opposite longitudinal direction from the other. Means are provided for simultaneously moving the moderator elements in opposite directions over substantially equal distances but not more than the given distances. (B.L.M.)

10347 NUCLEAR REACTOR FOR UNDERGROUND INSTALLATION IN DRILL HOLES. Janner, Karl; Braun, Wolfgang; Winkler, Franz (to Siemens-Schuckertwerke AG). U. S. Patent 3,319,537. Nov. 23, 1965. Priority date May 23, 1962, Germany.

A nuclear reactor is designed for underground installation by insertion through a borehole. The drill hole is widened at the bottom so that a space or chamber of larger diameter is made available. The reflector may be lowered in separate portions through the drill hole so that the portions lock themselves together upon entering the enlargement to form a widened casing-shaped structure into which the self-stabilized homogeneous reactor is lowered. A heat exchanger is joined to the reactor in the borehole. A circulatory primary flow path for the nuclear fuel is provided through the reactor and exchanger, while the heat exchanger has a secondary flow path with an external secondary liquid to be heated subterraneously. Gas duct means for protective gas is provided in the underground unit. A number of sensors responsive to reactor operation are located at different points on the unit, and electrical signal leads connected to the sensors extend upwardly to above ground. Flexible tubes extend upwardly to above ground for the primary flow path for fuel and from the gas duct means. (B.L.M.)

10348 NUCLEAR REACTORS. Webb, John; Friar, Harold (to United Kingdom Atomic Energy Authority). U. S. Patent 3,219,539. Nov. 23, 1965. Priority date July 3, 1961, Great Britain.

A design of a reactor of the type in which the reactive core is submerged in a mass of liquid coolant having a free surface is provided to prevent intermixing of the coolant and the gas above its free surface. An elongated casing sealed in a gas-tight manner at its upper end extends into the coolant mass from above its free surface and opens at its lower end into a low pressure plenum. The sealed upper end of the casing serves to trap gas by means of which the coolant level within the casing is adjustable. Means are provided at the upper end of the casing to control a pressure differential between gas trapped within the casing and the blanket gas above the coolant surface. (B.L.M.)

10349 FUSED-AND-VAPORIZED FUEL TYPE REACTOR. Torikai, Kinichi (to Japan Atomic Energy Res. Inst.). Japanese Patent 1964-18482. Aug. 31, 1964. Filed Jan. 16, 1962.

In the reactor proposed, erosion by the flowing fused fuel and the escape to the outside of the reactor core of delayed neutrons are prevented, and the danger of abrupt increase of the nuclear reactions by fusion of the distributed fuel is eliminated. The heat exchanger associated with the reactor is so installed that it surrounds the reactor core and serves as the walls of a containment vessel. By means of the heat exchanger, self-control of the reactor is achieved by repeated vaporization and condensation of the fused fuel. (NSA of Japan)

Fuels

Refer also to abstracts 9380, 9389, and 9702.

10350 (BNWL-152) PHOENIX FUEL PROGRAM PROGRESS REPORT, FY-1965. Hofmann, P. L. (comp.) (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Aug. 15, 1965. Contract AT(45-1)-1830. 38p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

The utilization of Hx–Pu ("high-exposure," composition 50% ^{239}Pu, 31% ^{240}Pu, 17% ^{241}Pu, and 2% ^{242}Pu) in water-moderated cores is found to permit reduction in shim control requirements. Further reductions come about because of the reduced peak xenon poisoning in the Pu cores. The reduced control requirements should make it possible–in principle–to obtain simple, compact core designs at low cost. The use of burnable poisons in intimate contact with the Pu fuel can result in further improvements in reactivity-lifetime characteristics. The large Pu cross sections make it possible to avoid the extensive use of self-shielded (lumped) burnable poison elements and thus, again, lead to core-design simplifications. Improvements in reactivity-lifetime characteristics may be achievable in reactors, using non-hydrogenous moderators. The negative ^{240}Pu Doppler temperature coefficient can be utilized to improve the safety characteristics of the core. Disadvantages of the Pu burner include low control rod worths, which tend to increase control requirements, and spatial power peaking, which might arise in the short-diffusion-length Pu cores. Studies are reported that are aimed toward establishing a sound physics basis for Phoenix reactors, and to assess the possibility of carrying out a full scale Phoenix power demonstration experiment. (auth)

10351 (EURAEC-1355) NUCLEAR VAPOTRON. Quarterly Report No. 1, November 1–December 31, 1963. (Compagnie Francaise Thomson-Houston, Paris. Allgemeine Elektrizitaetsgesellschaft, Frankfurt am Main (West Germany). Societe Alsthom, Paris (France)). Contract 034-63-11-TEEC(RD). 18p. (EUR-2330). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

Work Performed under United States–Euratom Joint Research and Development Program.

Due to pressure failures and unstable flow in the test loop, modifications consisting chiefly of placing a pressurizer between the test cell and the steam-water generator were made. The pressurizer is described. Cross sections of the finned vapotron cans which will be tested are given. Some pressure measurements in test loop are reported. (M.O.W.)

10352 FUTURE DEMAND FOR URANIUM. Raggatt, H. G. At. Energy Austral., 8: 2-13(Oct. 1965).

An assessment is made of the future demand for uranium in terms of the rate of growth in consumption of electricity throughout the world and the percentage of world requirements of electricity likely to be supplied by nuclear plants. Forecasts of electricity consumption in the U.S.A. and in Europe are reviewed and estimates of the world nuclear capacity are summarized. It is concluded that between 1975 and 1980 world demand for uranium will substantially exceed the production potential of known deposits from which production is profitable at $8/lb. (U. S.), that substantial new deposits or reserves must be brought into

production during that period, and that after 1975 the price of uranium oxide is likely to rise to not less than $10/lb (U. S.) (L.B.S.)

10353 THE PREDICTION OF INSTANTANEOUS COLLAPSE PRESSURE FOR FUEL ELEMENT CLADDING FOR PRESSURIZED WATER REACTORS. Howl, D. A. (United Kingdom Atomic Energy Authority, Springfields, Eng.). J. Brit. Nucl. Energy Soc., 4: 337-43(Oct. 1965).

A method of predicting the instantaneous collapse pressure of thin-walled tubes under a uniform external pressure is discussed in which allowance is made for the variation in Poisson's ratio. It is shown that predictions by this method are in good agreement with experimental results for type 304 stainless steel tubing closed at both ends by relatively massive end plugs. (D.C.W.)

10354 MATERIALS USED IN NUCLEAR ENGINEERING. Frost, B. R. T.; Waldron, M. B. (Atomic Energy Research Establishment, Harwell, Eng.). J. Joint Panel Nucl. Marine Propul., 9: 15-25(Oct. 1965).

The important characteristics of those fuel and structural or cladding materials that are relevant to small reactor systems including marine reactors are reviewed. Most of such reactor concepts are currently based on UO_2 clad in stainless steel or Zircaloy, but fuels other than bulk oxide have claims for consideration including alloys and cermets, although high integrity to high burnup must be achieved. The long term possibility of using plutonium enrichment has been considered in relation to the main types of fuel. Metallic fuels provide good neutron economy and major advances, in the last two years, point the way to achieving high burnup with little swelling. Ceramic fuels can achieve burnups of 50,000 Mwd/te without excessive swelling, but provision must be made for high fission gas release. An alternative approach is to retain the fission products within the fuel by dispersing small particles in a metal matrix which improves the thermal conductivity and restrains swelling. Such cermets offer high reliability at some expense in neutron economy. Stainless steel and zirconium alloys are capable of meeting operational requirements provided account is taken of embrittlement and corrosion problems. (auth)

10355 IMPROVEMENTS IN OR RELATING TO FUEL ELEMENTS FOR GAS COOLED NUCLEAR REACTORS. Barr, Peter; Gough, John Richard Cox (to United Kingdom Atomic Energy Authority). British Patent 1,010,268. Nov. 17, 1965. Filed Apr. 8, 1963.

A fuel element for a gas cooled reactor is made up of an outer container enclosing an annular fuel body composed of a number of part annular segments and a radially resilient member. The radially resilient member is a cylindrical spin having a longitudinal split extending through the wall of the spine, and the member serves to urge the outer surface of the fuel body into intimate contact with the adjacent surface of the container to increase the rate of heat transfer between the body and the container. (B.L.M.)

10356 IMPROVEMENTS IN ELEMENTAL FUEL CELLS FOR HEAVY WATER MODERATED NUCLEAR REACTORS. (to European Atomic Energy Community). British Patent 1,010,524. Nov. 17, 1965. Priority date Apr. 17, 1962, Italy.

An elemental fuel cell for a heavy water moderator reactor consists of an external jacket, a cluster of rods of fissile material held within the jacket by cross-members secured to the jacket, and a thermal insulating sheath on the outside of the jacket. This sheath is adapted to occupy the space between the jacket and a pressure tube when the cell is in position in the reactor. Means are provided on the jacket for retaining the sheath against axial movement along the jacket. Seating means at one or each end of the cell provide for the alignment of the ends adjacent cells; and several such cells may be aligned within a cold pressure tube so that the jackets form a continuous tube for the flow of cooling fluid, and the sheaths form a continuous thermal screen. (B.L.M.)

10357 IMPROVEMENTS RELATING TO NUCLEAR REACTOR FUEL ELEMENTS. Brock, Peter (to United Kingdom Atomic Energy Authority). British Patent 1,010,901. Nov. 24, 1965. Filed Mar. 3, 1961.

A reactor fuel element is described in which the sheathing encasing the fuel also contains both a heat transfer medium that is liquid at the operating temperature of the element and a gettering material for extraneous substances in the heat transfer medium. The gettering material is in contact with the heat transfer medium and serves in a non-structural role. The extraneous substances usually to be removed are H_2 and O_2. (B.L.M.)

10358 METHOD AND APPARATUS FOR MAKING NUCLEAR FUEL. Saums, Clyde H. (to General Electric Co.). Canadian Patent 717,434. Sept. 7, 1965.

To reduce the effect of unfavorable thermal conductivity in reactor fuel rods, an annularly loaded element is proposed. Either a core of fertile material coated with a suitably thick layer of fissile elements or a tubular element with fissile material on both inner and outer surfaces may be used. Thus the coolant is brought nearer the heat source. A die and mating ram used in fabrication is described along with details of the compacting process. (F.S.A.)

10359 FUEL ROD. Morita, Takahiro (to Hitachi, Ltd.). Japanese Patent 1964-10434. June 12, 1964. Filed Nov. 22, 1961.

An improved fuel rod is patented in which the temperature limitation on the center of the rod is mitigated. The rod consists of center and outer parts with differing thermal properties. The center fuel material has a larger thermal conductivity or higher melting and transformation points than the outer material. In the case of liquid fuels, the center has the higher boiling point. (NSA of Japan)

10360 FUEL ELEMENT. Yasujima, Kenryo (to Hitachi, Ltd.). Japanese Patent 1964-18479. Aug. 31, 1964. Filed Jan. 23, 1962.

An arrangement is described for supporting very long fuel elements securely in a reactor. At the midpoint of the long fuel element, a ball within the element cladding tube replaces the fuel material. A ring-shaped receiving plate is fixed on the outside of the tube at the same point. A horizontal fuel element supporting rod with a spherical end fits into the ring-shaped plate. Supporting rods from opposite directions press the fuel element tightly. (A.G.W.)

10361 FUEL ELEMENT AND METHOD OF OPERATING REACTOR. Teitel, Robert J. (to Dow Chemical Co.). U. S. Patent 3,216,901. Nov. 9, 1965. Filed Aug. 24, 1960.

A reactor fuel element comprises a relatively unmoderated reservoir for liquid fuel, a plunger associated with the reservoir, a moderated zone associated with the plunger, and pneumatic piston means. The piston means includes a piston reciprocable within a complementary cylindrical space in a container that is in communication with the reservoir, and the pneumatic piston means is attached to the plunger and adapted to move the plunger into the reservoir to transfer the liquid fuel from the reservoir to the moderated zone by positive displacement. The piston is actuated in a vertical direction by the application of gas pressure supplied either via a tube or pipe above or below the piston. (B.L.M.)

10362 FUEL ELEMENTS FOR NUCLEAR REACTORS. Challender, Ronald Scott; Saunders, Alan Charles Anthony (to United Kingdom Atomic Energy Authority). U. S. Patent 3,216,904. Nov. 9, 1965. Priority date June 27, 1960, Great Britain.

The protective outer sheath of a fuel element is provided with helical heat transfer fins extending from the outer surface of the sheath. Four longitudinal splitter fins are spaced substantially uniformly around the sheath and intersect the helical fins. The splitter fins have a greater radial depth than the helical fins, and one of the splitter fins is of uniform depth throughout its length. The other three splitter fins have portions of reduced radial depth extending over the greater part of the length and have projecting portions of the same radial depth as the splitter fin of

uniform depth. The portions of reduced depth occur at the ends and center of the fins. (B.L.M.)

10363 FUEL ELEMENT FOR A STEAM SUPERHEAT BOILING WATER NUCLEAR REACTOR. Stoker, Donald J.; Mims, Lisso Stewart; Siegel, Sidney (to North American Aviation, Inc.). U. S. Patent 3,218,237. Nov. 16, 1965. Filed July 3, 1959.

A combination fuel-moderator element is provided for a nuclear superheater. The element has a tubular frame having an interior and exterior wall, and the interior wall forms a coolant flow channel. Coolant inlet and outlet means are provided at opposite ends of the channel. The walls form a closed container, and a solid moderator is in the container. A number of tubes are provided for supporting fissionable material within the channel in spaced relation with and surrounded by the closed container, and each of the tubes contain a portion of fissionable material. A perforated plate interconnects respective ends of the tubes for maintaining the tubes in spaced relation, and the perforations connect coolant flow channels with the space between the tubes. The fuel-containing tubes are resiliently supported. (B.L.M.)

10364 FISSION ELECTRIC GENERATOR. Webb, James E. (to National Aeronautics and Space Administration). U. S. Patent 3,219,849. Nov. 23, 1965. Filed June 20, 1962.

A fission electric cell is patented in which a uniquely arranged anode having relatively thin walls and an enclosing envelope maintained at essentially the same potential as the cathode is used to cause the normally detrimental beta decay and Compton effects to increase, rather than decrease, the flow of current from the cathode to the anode. A number of the cells may be disposed in a cluster so that the aggregate quantity of fissionable material in the cluster exceeds a critical value so that a region of neutron bombardment is established within the cluster of cells. (B.L.M.)

Power and Power-Breeder Reactors

Refer also to abstracts 9357, 9655, and 10284.

10365 (ANL–7117) INSPECTION, EVALUATION, AND OPERATION OF THE EBWR REACTOR VESSEL. Balai, N.; Sutton, C. R.; Wimunc, E. A.; Jones, R. F. (Argonne National Lab., Ill.). Nov. 1965. Contract W-31-109-eng-38. 58p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

Examination of the EBWR pressure vessel is discussed. The interior upper half of the vessel was accessible for inspection (the lower half being inaccessible) where the exposed surface of the cladding was subjected to visual and dye-penetrant examination. Minor cracks and surface decorations were found in the stainless-steel Type 304 cladding; in many instances, gas tests revealed them to be through cracks. As a result of these preliminary findings, a more extensive investigation was initiated to assure that cracks did not propagate into, or develop in, the SA-212-B carbon-steel pressure vessel. This included the removal of boat samples from the reactor vessel for metallographic and chemical analysis, and the examination of similar and related materials. The findings of this investigation, their significance, and the considerations relating to the future operation of the reactor are described. (M.O.W.)

10366 (APDA–178, pp 10-17) PASTE CONCEPT FOR FAST REACTOR BLANKET APPLICATIONS. Kovacic, E. C.; Chamberlain, H. V.; Moore, C. R. (Atomic Power Development Associates, Inc., Detroit, Mich.).

Operation of the irradiation test loop with the stainless steel particles was continued to further investigate the problems of carryover of particles from the main paste circulating circuit, difficulties in returning the particle carryover to the main circuit, and difficulties with restarting of paste flow following inadvertent shutdowns of the loop. Loop testing was conducted at 500 to 700°F for the purpose of investigating the effect of loop temperatures on the paste flow rate. Upon successful completion of this phase of the work, the stainless steel particles were removed and the loop was operated with just sodium circulating for the purpose of recalibrating the flowmeters and rechecking the loop flow characteristics. Testing with the uranium carbide particles in the loop was initiated. (M.O.W.)

10367 (CONF-650620, pp 133-42) THE UNITED KINGDOM LIQUID METAL DEVELOPMENT PROGRAMME. Evans, P. B. F. (Reactor Group, United Kingdom Atomic Energy Authority, Risley (England)).

Coolant loop component development and testing facilities are described. (W.L.G.)

10368 (CONF-650620, pp 143-55) A CEA-EURATOM CONTRIBUTION TO THE SODIUM TECHNOLOGY. Robin, M. G. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). [Centre d'Etudes Nucleaires]).

Experience with steam generators, which are considered a major problem in sodium technology, and the experimental determination of sodium heat transfer coefficients are discussed. (W.L.G.)

10369 (CONF-650620, pp 276-80) EXAMINATION OF THE FERMI COLD TRAP. Herb, J. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.).

The performance of the nonradioactive primary sodium cold trap from the Fermi Atomic Power Plant is evaluated. (W.L.G.)

10370 (EUR-2474.e) SIMULATION OF ^{239}Pu FUELED CORES BY MEANS OF ^{239}Pu–^{235}U FUELED CORES IN FAST CRITICAL ASSEMBLIES. Ancarani, A. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik). Dec. 8, 1964. 100p. Dep. mn.

The possibility to simulate reflected spherical ^{239}Pu fueled fast reactors by means of reflected spherical zoned ^{239}Pu–^{235}U fueled fast reactors is investigated in some detail. The peculiar features of several criteria related to how to compare one reactor to another are presented and discussed. (auth)

10371 (EURAEC–1381) RESEARCH PROGRAM FOR THE GARIGLIANO NUCLEAR POWER PLANT. Report No. 4. (Societa Elettronucleare Nazionale, Rome (Italy)). Apr. 1, 1965. Contract 101-63-11-RDI. 9p. (EUR-2344). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

Work Performed under United States–Euratom Joint Research and Development Program.

Further research development was reported on the data logging computer system, instrumented assemblies, analysis of nuclear steam supply system performance, and some stability analyses and tests. (M.O.W.)

10372 (GA–6296) EXPERIMENTAL BERYLLIUM OXIDE REACTOR PROGRAM. Quarterly Progress Report for the Period Ending March 31, 1965. (General Atomic, San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science). Apr. 28, 1965. Contract AT(04-3)-187. 33p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

Analysis of the results of the fuel pin cycling tests mock-up continued. Helium leak testing was performed on the pin showing the highest leak rate. Metallographic examination of cladding specimens was completed, with specimens appearing to be in excellent condition, except for a surface oxide. Continuing effort is being made to understand more of the mechanism responsible for pin bowing. Elevated temperature testing of the tipping reflector pneumatic actuator continued. The device tripped satisfactorily after holding in air at 800°F for 1000 hr. Following temperature testing, a soak test of 2000 hr was initiated. Manufacturing drawings for dummy core elements were completed and released for fabrication. These elements consist of aluminum tubes with aluminum end fittings, and are filled with gypsum plaster to satisfy the nuclear requirement. Several malfunctions occurred in the scram motor in which scoring between the motor housing and gears had taken place.

After close inspection of a second motor and subsequent shimming of gears, the unit was successfully tested through 17 scrams. Facility operation and training are outlined, and construction engineering is discussed. (M.O.W.)

10373 (GAMD-6674) OPUS—A POWER PLANT PERFORMANCE ANALYSIS PROGRAM. Freudiger, F. S.; Gratteau, J. E. (General Atomic, San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science). Aug. 27, 1965. Contract AT(04-3)-167. 66p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

A power-plant performance analysis program (OPUS) written mainly in FORTRAN IV for use with an IBM 7044 computer is described. This code generates a flow network for a power plant of specified electrical output (in the range of 100 to 1000 Mw) according to input data specifications and programmed rules, proceeds to evaluate the plant performance and the price of the turbogenerator set (according to General Electric data), and prints as a result a coded list of all plant components and a detailed performance map. On the average, it takes 2 min to solve a problem equivalent in complexity to a standard 300 Mw plant configuration. Systems as well as operating conditions may be selected by the code within given limits. (auth)

10374 (GAMD-6745) MAXIMUM CORE COOLING DURING START UP OF THE PEACH BOTTOM REACTOR. Hansen, R. H.; Hunt, P. S. (General Atomic, San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science). Oct. 7, 1965. Contract AT(04-3)-314. 8p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

In order to perform certain physics experiments during startup of the Peach Bottom Power Reactor, it is necessary to keep the reactor core as cool as possible. This is accomplished by circulating the maximum amount of helium through the core at a given thermal power level, consistent with external operating constraints. Modifications made to the SSHB computer code to obtain these calculations are discussed. The results of the calculations are presented. (M.O.W.)

10375 (NAA-SR-11650, Sect. 2) SODIUM-REACTOR EXPERIMENT ADVANCED SODIUM-COOLED REACTORS AND SODIUM-COMPONENT DEVELOPMENT. (Atomics International, Canoga Park, Calif.). 26p.

Operation of the SRE during this period is discussed with respect to engineering changes. High temperature strain measurements are presented. The development of strain gages and other components for use in the 1200°F sodium is discussed. (M.O.W.)

10376 (NAA-SR-11650, Sect. 3) HALLAM NUCLEAR POWER FACILITY AND PIQUA NUCLEAR POWER FACILITY. (Atomics International, Canoga Park, Calif.). 19p.

A brief discussion of work carried out at the HNPF is presented. The design of SAP clad UC fuel elements for core II of the PNPF is presented. Data are given for the design of core II. Included are data on heat transfer and thermal analysis, core geometry, and a nuclear analysis of the core. A brief report on the PNPF catalytic hydrocracking coolant processing system is presented. (M.O.W.)

10377 (NAA-SR-Memo-11433) LARGE SGR CREEP ACCELERATION TEMPERATURES. Todd, R. (Atomics International, Canoga Park, Calif.). Apr. 21, 1965. Contract AT(11-1)-Gen-8. 10p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

Three possible bases or creep equations for determining the accelerated creep test temperature were investigated. Two of these laws are based on empirical data alone and are basically curve fitting equations applied to available creep rate data for 304 stainless steel. The third equation is based on activation energy principles and the results it produces are not derived from empirical data. (auth)

10378 (NAA-SR-Memo-11607) HNPF—STRESS CORROSION STUDY. Landler, G. (Atomics International, Canoga Park, Calif.). Aug. 30, 1965. Contract AT-11-1-GEN-8. 47p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

The failure of expansion tank #3 called attention to the possibility of there being other weldments in sodium system components with the same corrosive deposits and therefore possibly subject to stress corrosion cracking. The requirements for such stress-corrosion cracking are only imperfectly known at this time but appear to be a deposit of corrosive media, such as chloride, the presence of moisture at some time and at least a moderate stress level. Examination of drawings and specifications indicate that a large number of weldments can be identified in the HNPF sodium systems which may meet some or all these requirements. The only sure method of locating points of incipient trouble is a destructive examination, although ultrasonic testing may be satisfactory in certain idealized circumstances. Many of the suspect weldments cannot be inspected because of the radiation levels or physical inaccessibility. In the most favorable circumstances, it is necessary to remove insulation, electrical heaters and in some instances, heater jackets. (auth)

10379 (RT/FI(65)38) CALCOLO DELLA MASSA CRITICA DEL REATTORE DEL GARIGLIANO. (Calculation of Critical Mass for Garigliano Reactor). Eletti, G.; Faetti, A.; Loizzo, P.; Manca, G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Sept. 1965. 24p. Dep. mn.

The values of the critical mass of the Garigliano Reactor were obtained by means of calculation methods generally used for light water reactors. The effects of possible variations in the use of these methods were examined. The results of these calculations are in good agreement with the experimental data. (auth)

10380 (TID-22438) HAZARDS ANALYSIS BY THE DIVISION OF REACTOR LICENSING IN THE MATTER OF NIAGARA MOHAWK POWER CORPORATION NINE MILE POINT NUCLEAR STATION, OSWEGO, NEW YORK. (Division of Reactor Licensing (AEC), Washington, D. C.). [nd]. 85p. (DOCKET-50-220). Dep. mn; CFSTI $3.00 cy, $0.75 mn.

Important safety considerations are discussed in terms of the site, facility design, and engineered safeguards. Accident analyses were made on a steam line break, loss of coolant accident, refueling accident, control rod ejection accident, and zirconium-water reactions. (M.O.W.)

10381 (TID-22467) 237 MW KRB NUCLEAR POWER PLANT. Quarterly Report No. 9, April 1–June 30, 1965. (Kernkraftwerk Rwe-Bayernwerk G.m.b.H., Gundremmingen (West Germany)). 132p. (KRB-1965/2). Dep. mn; CFSTI $4.00 cy, $1.00 mn.

Work Performed under United States–Euratom Joint Research and Development Program.

Work conducted during this period is reported on construction progress, preliminary tests, diagrammatical representation of construction status, status of total project, and the work schedule. (M.O.W.)

10382 (WCAP-3269-13) LARGE CLOSED-CYCLE WATER REACTOR RESEARCH AND DEVELOPMENT PROGRAM. Progress Report, April 1–June 30, 1965. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.). Contract AT(30-1)-3269. 91p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

A summary of physics calculations for 3 water moderated uranium dioxide critical assemblies is presented. Irradiation testing of an advanced fuel assembly is discussed. The performance of Zircaloy clad fuel rods is discussed. Dimensional stability studies of uranium dioxide fuel elements were made. Various loadings were applied to a new prototype fuel element and tests were made to determine the axial load-deflection characteristics, lateral bending-deflection characteristics, torsional characteristics, natural frequency, and column stability. Results of these tests are presented. Coupon specimens of various materials were exposed in the outlet side of the Saxton steam generator for 14.6 months to the reactor primary system fluid at about 515°F. All specimen materials were defilmed and the defilming solutions analyzed both chem-

ically and radiochemically. The results of these analyses are presented. Some chemical studies of soluble neutron poisons were made. A loss of coolant flow is described theoretically. Calculations were made for the power distribution in a reactor core with Zircaloy and stainless steel clad regions. (M.O.W.)

10383 (WCAP-4321) EXAMINATION OF THE ENRICO FERMI SODIUM COLD TRAP. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.). Nov. 1965. Contract AT(30-1)-3186. 195p. Dep. mn. CFSTI $5.00 cy, $1.00 mn.

Westinghouse Atomic Power Division sampled and analyzed the contents, and evaluated the performance, of a sodium cold trap removed from service at the Enrico Fermi Atomic Power Plant. The trap, a 500 gallon vessel packed with stainless steel wire mesh, operated for 3700 hours in the primary sodium system. An effective method was developed, and employed, to remove fifty-five representative sodium-mesh samples from selected regions of the non-radioactive cold trap. Methods for determining the impurities of interest in the samples from the trap were adapted from procedures described in the technical literature. Based on the chemical analyses of the trap contents, less than 20% of its designed oxygen removal capability was realized. Most of the contaminants were concentrated in the lower mesh region. The trap contained an estimated 50 pounds of oxygen, 0.9 of a pound of carbon, and smaller amounts of carbonate, hydrogen, and nitrogen. Spectrographic analyses for metallic impurities revealed high concentrations of copper (up to 360 ppm) and iron (up to 165 ppm). Although a section of the innermost cylindrical wall had partially collapsed and a portion of the lower mesh had been displaced, the cold trap operated satisfactorily. There was no evidence of flow maldistribution. (auth)

10384 (EURFNR-3F) KARLSRUHE FAST BREEDER PROJECT. Third Quarterly Report, 1964. Faude, D. (comp. and ed.) (European Atomic Energy Community. Kernforschungszentrum, Karlsruhe (West Germany)). Translation of a German report. Sept. 1964. 27p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

Work Performed under United States–Euratom Fast Reactor Exchange Program.

A review is presented of the design, preparation, and operations of SNEAK; criticality and startup experiments in STARK; activities at SUAK; theoretical studies connected with SEFOR; boron and zirconium additive effects in Inconel X; corrosion of Inconel 600, Inconel X750, and Incoloy 800 by steam; dissolution of UO_2–Mo systems using HNO_3; and other activities concerned with fast breeder reactor development. (T.F.H.)

10385 (EURFNR-10F) USE OF THE RAPSODIE REACTOR FOR MEASUREMENT OF THE DOPPLER COEFFICIENT OF FAST POWER REACTORS. Zaleski, C. P.; Abdon, R.; Ladet, J.; Puig, I. P.; Stevens, L. (Commissariat a l'Energie Atomique, Cadarache (France). Centre d'Etude Nucleaires). Translation of report CEA-R-2565. June 1964. 37p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

Work Performed under United States–Euratom Fast Reactor Exchange Program.

The Rapsodie reactor will be used to obtain approximate measurements of the Doppler coefficients of fast power reactors. The static and oscillation methods will be used in Rapsodie to obtain the measurements. A detailed analysis of each method along with a discussion of errors in the calculations is presented. (M.O.W.)

10386 ORGEL—A EUROPEAN POWER REACTOR PROGRAM. Tauch, Peter (EURATOM, Ispra, Italy). At. Strom, 11: 81-7(Aug. 1965). (In German).

The "Orgel" Project, a heavy water-moderated and organic-cooled pressure tube reactor, is described. Development and essential data of a 250-Mw installation are recorded. A low enrichment of the fuel material permits a further decrease in the already low cost of the fuel cycle of the reactor, which is based on a good neutron economy for utilization with natural uranium. The nuclear data for installations with both natural uranium and slightly enriched uranium fuel are reported. The economic aspects of the "Orgel" reactor concept are discussed. (tr-auth)

10387 DUNGENESS "B"—THE FIRST NUCLEAR POWER PLANT OF THE SECOND BRITISH NUCLEAR ENERGY PROGRAM. Mackenthun, W. At. Strom, 11: 87-92(Aug. 1965). (In German).

Design data for the reactor and steam generator installation of the Dungeness "B" reactor are tabulated and discussed. The fuel elements and control devices are described. The safety of this reactor concept is considered. Economic studies made on AGR-type reactors are reviewed. (J.S.R.)

10388 ATOMIC ENERGY FROM RAW MATERIALS UP TO NETWORK CONNECTIONS. IMPRESSIONS OF THE SECOND FORATOM CONGRESS. Wirtz, K. (Kernforschungszentrum, Karlsruhe, Ger.). Atomwirtschaft, 10: 658-62(Dec. 1965). (In German).

The second Foratom Congress was divided into four sections, the first of which had two parts, one on uranium reserves and the other on fuel elements. Section two considered present nuclear power plant types. Section three considered the introduction of nuclear power plants into the electrical network. The furture utilization of atomic energy in Europe was considered in the fourth section. A brief summary is given of the most important data and conclusions from each section. (J.S.R.)

10389 PRESENT NUCLEAR POWER PLANT TYPES. REPORT ON SECTION II OF THE FORATOM CONGRESS. Finke, W. (Bundesministerium fuer Wissenschaftliche Forschung, Bad Godesberg, Ger.). Atomwirtschaft, 10: 664-6(Dec. 1965). (In German).

The broadly based development of prototypes is increasing under time and competition pressure. The nuclear energy programs of Great Britain, Germany, Italy, and France for the development and exploitation of new reactor types are summarized. (J.S.R.)

10390 THE INTRODUCTION OF NUCLEAR POWER PLANTS INTO THE ENERGY NETWORK. REPORT ON SECTION III OF THE FORATOM CONGRESS. Kempken, M. (Bundesministerium fuer Wissenschaftliche Forschung, Bad Godesberg, Ger.). Atomwirtschaft, 10: 666(Dec. 1965). (In German).

The introduction of nuclear power plants into the electrical system of Europe is discussed. It is predicted that the capital risk, especially fuel element cost, will become smaller than that for conventional heating power plants. It is shown that the energy supply for primary sources would be increased by the use of nuclear power plants. (J.S.R.)

10391 THE DECISION ON DUNGENESS B. Berry, D. J. (United Kingdom Atomic Energy Authority, London). Atomwirtschaft, 10: 671-6(Dec. 1965). (In German).

The economic and engineering factors that led to the decision in favor of the Dungeness B AGR reactor are discussed. The development potential of this reactor type is considered. (J.S.R.)

10392 THE ECONOMIC FUTURE OF THE AGR IN GERMANY. Atomwirtschaft, 10: 676-7(Dec. 1965). (In German).

The transference of cost calculations for the Dungeness B reactor to other countries, especially Germany, is considered. (J.S.R.)

10393 NUCLEAR SUPERHEAT. Symes, R. J. (Atomic Energy Establishment, Winfrith, Eng.). Elec. Rev., 177: 126-31(July 23, 1965).

The coolant cycles of nuclear power reactors are discussed in terms of the two types, direct and indirect (depending on whether the reactor coolant constitutes the working fluid of the power plant). Direct cycle developments are discussed, and the advantages of superheat are enumerated. Selection of cladding materials is considered. So far, no single alloy has been found that fulfills all the requirements for such materials. Illustrations of practi-

cal superheating systems are given which indicate the trend towards improving the efficiency of water reactors by introducing nuclear superheat. (TCO)

10394 A PROCEDURE TO ANALYZE THE ROD DROP EXPERIMENTS. Prosperi, M. (Laboratori Riuniti Studi e Ricerche, Milan). Energia Nucl. (Milan), 12: 577-81(Nov. 1965).

A procedure of subcritical calibration is given which is based on the analysis of the so called rod drop experiments. It differs from the conventional procedure as it takes into account the spatial dependence of the flux transient. The transient analysis, on which our procedure is based, is obtained by expanding the flux in terms of the eigensolutions of a suitable Sturm-Liouville system, with space dependent parameters. In such a way a procedure is obtained which takes into account the space dependence of the reactor parameters as well as the characteristics and distribution of the inserted control rods. Finally a numerical application referring to the Latina Power Station is given. It is shown that the proposed procedure leads to a determination of the unknown reactivity, which is much more accurate than that achieved by means of conventional approaches. (auth)

10395 THE WORK DONE BY EURATOM IN THE FIELD OF THE BUILDING OF NUCLEAR POWER STATIONS. Parker, E. Energie Nucl., 7: 266-71(July-Aug. 1965). (In French).

The role played by Euratom (from the point of view of the establishment of nuclear power plants) in the six Common Market countries is discussed, taking into account their economic and industrial structure as well as the power available. Work in Germany, Italy, Belgium, the Netherlands, France, and Luxenbourg is reviewed. (M.C.G.)

10396 BRITISH NUCLEAR POWER PROGRAMME. Greenhalgh, G.-H. Energie Nucl., 7: 272-7(July-Aug. 1965).

The development of the nuclear power program in the United Kingdom is reviewed. The program is founded on the requirements that substantial amounts of nuclear power should be available by the middle of the 1970's, that it should be based initially on natural uranium fuel with a well-proved technology, that nuclear power must be cheap, and that in the long-term nuclear generation will depend on plutonium-burning fast reactors. The ways in which these requirements are being met are discussed. (M.C.G.)

10397 EFFORTS BY THE ITALIAN INDUSTRY IN THE NUCLEAR FIELD. Bullio, Pietro. Energie Nucl., 7: 283-9(July-Aug. 1965). (In French).

The Italian nuclear industry program is reviewed. The Trino, Garigliano, and Latina power stations are briefly described. The importance of Italian exports in the nuclear field, equipment and radioisotopes, is emphasized. (M.C.G.)

10398 PROSPECTS OF COVERING ELECTRICITY DEMAND BY NUCLEAR POWER. Mandel, Heinrich. Energiewirtsch. Tagesfrag., 14: 391-7(Sept. 1964). (In German).

Nine factors that affect the competitiveness of nuclear power plants with respect to conventional power plant are studied. These factors are: the specific plant cost, the interest and insurance, depreciation time, personnel cost, cost for maintenance and waste processing, availability of complete load, cost of the reactor core, burnup attainable, and net worth of the used fuel elements. It was shown that with increasing power the plant costs of nuclear power plants approach that of conventional power plants. The fuel element cost fraction of the kw hour contains some cost components that have not been sufficently checked by experimentation. Nuclear power plants should become competitive with fossil plants in the 1970's. Nuclear energy represents at the present an important supplementary primary energy source. (J.S.R.)

10399 STEAM AND CONDENSATE RETURN LINE CORROSION. Obrecht, Malvern F. (Michigan State Univ., East Lansing). Heat., Piping Air Cond., 37: 126-31(Nov. 1965).

Piping corrosion in central heating and nuclear power plants is discussed. Problems occur because of increased pressures in conventional boilers, introduction of supercritical and nuclear boilers, and peaking operation of utility boilers. Contaminants in the steam–water cycle of a turbogenerator system can cause serious difficulties. Mercury causes stress corrosion cracking of highly stressed copper alloys or of those containing high residual stresses. Mercury may gain access to steam–water cycles through pressure surges on manometers. Nickel, aluminum, and zinc pickup from condensate cycles may also be a problem. Another cause of corrosion is the presence of various gases: carbon dioxide, oxygen, ammonia, hydrogen sulfide, and sulfur dioxide. The most serious problem is hydrogen embrittlement, due to the development of initially unconnected microscopic voids of the steel grain boundary, apparently caused by methane, formed as hydrogen diffuses through the steel and reacts with the iron carbide in it. The soluble iron and copper and suspended oxide (crud) of the condensate and feedwater must be reduced to the lowest possible limits to prevent transport of corrosion products to the boiler or nuclear reactor proper. (TCO)

10400 IN-CORE NEUTRON FLUX INSTRUMENTATION. Forster, J. J. (General Electric Co., San Jose, Calif.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci., NS-12: 8-14(Dec. 1965).

A survey of new work on neutron monitoring in nuclear power reactors is presented. System specifications and life performance data are reviewed. Several innovative extensions of in-core monitoring such as the traversing probe and the Campbell method are covered in detail. (auth)

10401 SOME ASPECT OF PROTECTIVE SYSTEMS IN NUCLEAR POWER PLANTS. Garrick, B. J.; Gekler, W. C.; Pomrehn, H. P. (Holmes and Narver, Inc., Los Angeles). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci., NS-12: 22-30(Dec. 1965).

The technology and performance of nuclear power plant protective systems are discussed, and the philosophy of such systems in the nuclear industry are briefly reviewed. (L.B.S.)

10402 DUNGENESS B NUCLEAR POWER STATION. J. Brit. Nucl. Energy Soc., 4: 287-95(Oct. 1965).

The bases for the selection of the AGR system for the Dungeness B power station are discussed. (D.C.W.)

10403 IRRADIATION EXPERIENCE WITH BERKELEY PROTOTYPE ELEMENTS TO 5200 Mwd/te CHANNEL AVERAGE. Eldred, V. W. (Reactor Development Lab., Windscale, Eng.) Jackson, F.; Shaw, R. A. J. Brit. Nucl. Energy Soc., 4: 319-36(Oct. 1965).

The development of the Berkeley fuel element is briefly discussed, and an experiment is summarized in which prototype Berkeley fuel elements were irradiated in Chapelcross Reactor 3, starting in Sept. 1959. Channels were discharged at intervals for monitoring purposes; the last channel was discharged in Oct. 1964. None of the elements failed below a channel average of 4400 Mwd/t, well above the design value of 3300 Mwd/t. (D.C.W.)

10404 ON THE CHOICE OF OPTIMUM PARAMETERS OF A NUCLEAR POWER STATION. Christenko, P. J. (Inst. of Theoretical and Experimental Physics, Moscow). Jad. Energ., 11: 281-8(Aug. 1965). (In Czech.).

An approximation method is described for the determination of the optimum parameters of a nuclear power station with gas-cooled (or other nonboiling-medium-cooled) reactor. Temperature, flow rate of cooling medium, the height of a reactor, and filling of fuel element cross section with fuel are considered as the variable parameters. The optimization criterium is the minimum cost of electricity. (auth)

10405 STRESS DETECTION AT AN IRREGULARLY SHAPED COMPONENT FOR A NUCLEAR PLANT. Sturm, H. (Technische Ueberwachungsvereins Bayern e. V., Munich). Kerntechnik, 7: 504-5(Nov. 1965). (In German).

Stress detection in the pump enclosure of a boiling water

reactor is considered. Calculation methods for such detection are indicated, but it is simpler and cheaper to determine the stress by dilation methods. The model enclosure constructed to measure the stress of such an irregularly shaped component and the test results obtained are described. The stress was measured in both the longitudinal and latitudinal directions. (J.S.R.)

10406 INVESTIGATIONS OF EURATOM IN THE AREA OF DIRECT CONVERSION OF NUCLEAR PRODUCED HEAT INTO ELECTRICAL ENERGY. Neu, Helmut (Euratom, Ispra, Italy). Neue Tech., 5: 229-35(1965). (In German).

The reasons for the interest in direct convertors are briefly indicated. Research on thermionic convertors is summarized. The development of nuclear-heated convertors for in-core uses and heat transfer systems for space reactors is described. The significance and difficulties of thermionic research are discussed. (J.S.R.)

10407 FEASIBILITY OF IRRADIATION EXPERIMENTS IN THE DFR. Birss, I. R. (United Kingdom Atomic Energy Authority, Dounreay, Scotland). Nucl. Eng., 10: 465-8(Dec. 1965).

Methods of using neutron-flux and reaction-rate data to compute radiation dose and heat rating in a tested material are summarized. The important parameters of the irradiation experiment and the manner in which they can be reproduced in the DFR are described for four typical experiments: testing a fuel pin for a large fast reactor, testing a typical cladding material for a large fast reactor, testing a moderator for a gas-cooled reactor, and testing a structural material for a water reactor. (M.J.T.)

10408 APPROACH TO CRITICALITY OF THE ENRICO FERMI ELECTRONUCLEAR POWER PLANT. D'Angola, Luigi. Rivoluzione Ind., No. 138, 24-6(June 1965). (In Italian).

The Enrico Fermi Nuclear Power Plant is a pressurized natural water reactor. It is designed for a thermal power of 825 Mw. A brief description is given of the plant, and its characteristics are tabulated. (J.S.R.)

10409 FUEL MANAGEMENT IN STEAM GENERATING HEAVY WATER REACTORS. Hicks, D. (Atomic Energy Establishment, Winfrith, Eng.). 37p. (CONF-650602-74; AEEW-M-554). ORINS. Gmelin, AED-CONF-65-125-20.

From American Nuclear Society 11th Annual Meeting, Gatlinburg, Tenn.

Fuel management strategy studies for steam generating water reactors are described. The object of the studies is to devise schemes which achieve acceptable compromises between permissible power output and fuel cycle cost. Most of the studies reported relate to the 100 Mw(e) prototype SGHW, but some reference is made to larger reactors. (J.F.P.)

10410 A FUEL ELEMENT FOR THE IMPROVED CALDER HALL TYPE REACTOR. Sako, Jun (to The Japan Atomic Power Co.). Japanese Patent 1964-21417. Sept. 30, 1964. Filed Jan. 20, 1962.

A new fuel element is proposed for the Calder Hall type gas-cooled reactor. In the natural uranium fuel element, the spiral fin tube sleeve for an effective energy output has splitters with curved wall guides for gas outlet and inlet. These curved wall guides prevent effectively the occurrence of eddy currents in the cooling-gas flow. (NSA of Japan)

10411 VERTICAL NUCLEAR BOILER. Taylor, Anthony J. (to Babcock and Wilcox, Ltd.). U. S. Patent 3,216,400. Nov. 9, 1965. Priority date Feb. 25, 1959, Great Britain.

A tubular vapor generator is provided for a steam-generating system incorporating water-cooled reactors. The generator has a pressure vessel containing a bank of upright, spaced tubes with the ends shaped to extend laterally to tube plate means disposed at the inner ends of inlet and outlet chambers projecting laterally from the pressure vessel. A jacket surrounds the tube bank to form, between the tubes, an internal riser space open at the bottom to a liquid space of the vessel and in communication at the top with a vapor space of the vessel and, between the jacket and the wall of the vessel, a downcomer space. (B.L.M.)

10412 UNIFIED MODULAR REACTOR PLANT. Zmola, P. C.; Rickert, R. J.; Flinn, W. S. (to U. S. Atomic Energy Commission). U. S. Patent 3,226,300. Dec. 28, 1965.

A unified nuclear steam generator was developed in which the need for control rods was eliminated. The reactor is a pressurized-water unit incorporating within the pressure vessel steam generating apparatus. Reactivity of the core is regulated by steam demand, relying on the inherent load-following capability of a water reactor. Separate enrichment zones and the use of burnable poisons provide for lifetime reactivity control. (AEC)

Process Heat Reactors

Refer also to abstract 8903.

10413 (ORNL-TM-1329) FEASIBILITY OF OFFSHORE DUAL-PURPOSE NUCLEAR POWER AND DESALINATION PLANTS. Arnold, H. G.; Gall, W. R.; Morris, G. (Oak Ridge National Lab., Tenn.). Jan. 1966. Contract W-7405-eng-26. 112p. Dep. mn. CFSTI $4.00 cy, $0.75 mn.

The results of a study of the economic and technological feasibility of offshore desalination-power plants are presented. The use of a 3500-Mw(t) organic-cooled heavy-water-moderated reactor as the heat source for a 733-Mw(e) plant with an output of 2.5×10^8 gal/day of fresh water was considered. (D.C.W.)

10414 (TID-22330(Vol.1)) ENGINEERING AND ECONOMIC FEASIBILITY STUDY FOR A COMBINATION NUCLEAR POWER-DESALTING PLANT. PHASES I AND II. (Bechtel Corp., San Francisco, Calif.). Dec. 1965. 509p. Dep. mn; CFSTI $4.00 cy, $2.25 mn.

The finding and conclusions of economic and engineering feasibility studies of a combination power and desalting plant for operation in southern California are presented. Results of the study are given on the effect of blending at the Diemer plant, product conveyance and blending facilities, conceptual designs of sea water systems, nuclear site safety analysis, site selection, fossil versus nuclear fueled dual purpose plants, optimization of dual purpose plants, conceptual plant descriptions, plant capital cost estimates, and the cost of water. (M.O.W.)

10415 OPRESNENIE SOLENYKH VOD. METOD DISTILLYATSII S ISPOL'ZOVANIEM TEPLA YADERNYKH REACTOROV. (Desalination of Salty Waters. Methods of Distillation Using Nuclear Reactor Heat). Mal'tsev, E. D. Moscow, Atomizdat, 1965. 92p.

A brief review is given on various methods for desalination of saline waters. The use of hydrophobic coolants, intensification heat exchange by film formation by means of stationary column packing, removal of scum-forming salts by sorption on resins, followed by regeneration of the resins from the evaporators are described. The performance of nuclear reactors for desalination and production of electricity is also discussed. (R.V.J.)

Production Reactors

Refer also to abstract 10384.

10416 THE FUTURE OF SELF FERTILIZING REACTORS. Fiorio, Franco. Rivoluzione Ind., No. 139, 21-4(July-Aug. 1965). (In Italian).

The characteristics of self-fertilizing reactors are briefly indicated and the types of self-fertilizing reactors under construction are briefly discussed and tabulated. The long-range project of the United States AEC for the development of these reactors is indicated. (J.S.R.)

Propulsion and Space

See also ENGINEERING — Space Propulsion

10417 (NAA-SR-Memo-11635) SNAPSHOT FAILURE ANALYSIS REPORT. Final Failure Report. (Lockheed Missiles and Space Co., Sunnyvale, Calif. Atomics Inter-

national, Canoga Park, Calif.). Sept. 30, 1965. Contracts AF04(695)-136; AT-11-1-GEN-8. 370p. (LMSC–A764749). Dep. mn; CFSTI $7.00 cy, $1.75 mn.

An attempt is made to determine the cause of shutdown of the SNAP 10A/Agena spacecraft after 43 days of successful orbital operation. A brief history of the operating characteristics of the spacecraft up to the time of failure is included to provide a background helpful to a fuller understanding of the failure analysis. An extensive failure test program is instituted to determine the effects of both high and low voltage on most of the vehicle equipment that was energized immediately prior to failure. Since a high-voltage condition could only be caused by a voltage regulator failure, extensive testing is performed on this unit. Test results are summarized, and in the case of vehicle equipment known to have failed, other possible causes of failure are also discussed. Briefly, the results of the tests performed uphold the high-voltage failure sequence, beginning with a regulator failure and ending with a command decoder generating spurious commands to shut down the reactor and place the spacecraft in the observed configuration. This sequence is discussed step-by-step. (T.F.H.)

10418 (NASA–CR–54716) SNAP-8 MATERIALS REPORT FOR JANUARY–JUNE 1964. VOL. I. ELECTRICAL INSULATION DEVELOPMENT. Report No. 2880. Dillingham, R. P. (Aerojet-General Corp., Azusa, Calif.). July 1964. Contract NAS5-417. 50p.

Previously developed insulation systems were applied to SNAP-8 electrical components and their performance studied. The first inorganic-insulated stator was completed. (W.L.G.)

10419 (PWAC–468) SUMMARY REPORT OF POTENTIAL LIQUID METAL BEARING MATERIALS FOR SNAP-50/SPUR PUMPS. Wallace, M. J. (Pratt and Whitney Aircraft, Middletown, Conn. Connecticut Advanced Nuclear Engineering Lab.). Nov. 1965. Contract AT(30-1)-2789. 72p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

The compatibility and wear characteristics of selected bearing materials, including surface treatments and cemented refractory carbides, were investigated in support of the SNAP-50/SPUR pump development program for lithium and NaK systems. Compatibility of candidate materials with 1100F lithium in Cb-1 Zr alloy was studied in tilting capsule tests for durations to 7000 hours. The wear behavior of material combinations was evaluated with a rotating disk-static shoe assembly in lithium and NaK to 1000F. The best compatibility and wear characteristics were exhibited by high density molybdenum cemented carbides. Carburized Cb-1 Zr alloy wear resistance was inconsistent but, under the best conditions, was nearly equivalent to that of the cemented carbides. Plasma-jet sprayed coatings of tungsten carbides and WC–Co gave encouraging results in NaK, but additional development of the coating process appeared necessary, to assure reliable control of adhesion and performance. Based on the results of these tests, carburized Cb-1 Zr alloy and Kennametal K-7178 cermet were recommended as the materials for use in fabricating full size bearings to be tested at SNAP-50/SPUR pump bearing conditions. (auth)

10420 (TIM–824) USE OF HELIUM AND ARGON AS PROTECTIVE ENVIRONMENTS FOR SNAP-50/SPUR PROGRAM. Limoncelli, E. A. (Pratt and Whitney Aircraft, Middletown, Conn. Connecticut Advanced Nuclear Engineering Lab.). Nov. 1965. Contract AT(30-1)-2789. 80p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

A technology of purified noble gas handling was developed. Application of the gas handling methods has provided helium and argon with concentrations of reactive contaminants lower than the sensitivities of available instrumentation. Data were obtained to permit the design of reliable, guaranteed life purifiers to provide low contaminant gas. Methods of assembling non-contaminating plumbing and control systems for gas transport were developed and used. Instrumental methods of analysis for oxygen, nitrogen, carbon containing gases and water were evaluated and recommendations made for selection and use. Specifications necessary for implementation were prepared and are included. (auth)

10421 REACTOR PHYSICS CALCULATIONS FOR THE GASEOUS CORE CAVITY REACTOR. Kaufman, R. M.; Osborn, W. F. Jr.; Simmons, J. R.; Roth, E. B. Allison Res. Eng., 8: 11-18(1965).

A series of reactor physics calculations were performed for a gaseous-core cavity reactor using advanced transport codes in order to determine the critical mass of fuel required in the cavity and its variation with temperature, size cavity, and moderator-reflector materials. The critical mass calculations are fundamental to questions of feasibility from a structural and control standpoint. (L.B.S.)

10422 SOME ASPECTS OF THE PROGRESS OF A BELGIAN NUCLEAR PROJECT: THE VULCAIN REACTOR. Maldague, P. Energie Nucl., 7: 290-4(July-Aug. 1965). (In French).

The aim of the Vulcain project is to develop a compact reactor for low- and medium-power nuclear power stations or for nuclear-propelled ships. The relatively high investment cost, compared with that of a conventional boiler or a diesel engine, is compensated by lower fuel cost. The reactor uses slightly enriched uranium oxide as fuel and a mixture of heavy and light water as a moderator. The composition of the moderator is modified in stages as the core is exhausted. The Vulcain reactor differs from proved light water reactors in that its basic constituents are arranged in a very compact manner. The critical assembly Venus was used for experimental measurement of the neutron characteristics of the Vulcain cores. Core power tests were carried out, in the BR_3 reactor at Centre d'Etudes de l'Energie Nucléaire de Mol. (auth)

Research and Test Reactors

Refer also to abstract 10372.

10423 (APDA–178, pp 67-70) FAST FLUX TEST FACILITY. Amorosi, A., Duffy, J. G.; Macleod, R. A. (Atomic Power Development Associates, Inc., Detroit, Mich.).

Studies were made in connection with the design of the Fast Flux Test Facility. Brief summaries of these studies on core composition and arrangement, reactor configuration, and the bottom re-entry loop design are presented. (M.O.W.)

10424 (BNWL–166, pp 6.4-8) GAS LOOP DEVELOPMENT. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.).

Improvements in the gas cleanup system made it possible to clean up the gas in the model helium loop to less than 1 ppm total impurities at low temperatures. The loop was operated at varying flows and temperatures, and measurements were made on the pressure drop in the regenerative heat exchanger. The maximum drop in the shell side of the exchanger was 16.5 in. of water while the pressure drop in the tube side was 9.5 in. of water. Leakage flow tests on the labyrinth seal for the ATR Gas Loop heat shield were conducted for shield temperatures up to 1000°F. Problems with the heater have prevented the tests being run up to 2000°F as required. A mechanical tubing connector was tested for helium service. The connector was temperature cycled between –190 and 160°C. One connector was disassembled and reassembled 15 times. No leaks occurred on any of the tests with the helium pressure at 2100 psig. (auth)

10425 (EUR–2513.f) MESURE AU MOYEN D'UNE SOURCE PULSEE ET MODULEE DANS UN REACTEUR. (Measurements in a Reactor by Means of a Pulsed and Modulated Source). Rotter, W. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). 1965. 34p. (CONF-650504–45). Dep. mn.

From IAEA Symposium on Pulsed Neutron Methods, Karlsruhe, Ger.

A Philips generator, the neutron flow of which is variable with any time function, has evidenced its practical usefulness by a series of measurements carried out in the BR-2 reactor in the sub-critical state. Its good stability, combined with the possibility of abruptly varying the neutron intensity, pulsing the flow or modulating it sinusoidally, makes this generator a very flexible device. It can be used to determine the reactivity ($\rho = \Delta k/\beta k$) and the life of the neutrons (λ/β) by various independent methods. An accurate comparison of these methods is possible because they can be employed without modifying the measuring conditions. The transfer functions for a reactivity oscillator and for a sinusoidally variable source are discussed. It is shown to be possible to measure the reactivity ρ for $0.1\ \$ < \rho < 10\ \$$ by using a modulated source. This method gives the reactivity by means of the prompt neutrons/delayed neutrons ratio for an optimum frequency to all intents and purposes independently of the delayed neutron data and the λ/β value. By a combination of the modulation and pulsing methods, the life of the prompt neutrons (λ/β) can be measured over a broad range in the subcritical reactor. (auth)

10426 (NP-15687) ANALYSIS OF SPENT BGRR FUEL PLATE. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf). [1964]. Contract 314/RB. 17p. Dep. mn.

An irradiated fuel plate from the Brookhaven Graphite Reactor was measured with a Compton Spectrometer and analyzed for its aluminum and uranium content. Results of the analysis are presented. (M.O.W.)

10427 ON THE DISTRIBUTION OF SOME FISSION PRODUCTS BETWEEN CORE AND RECOMBINER OF L54M REACTOR. PART 3. DETERMINATION OF THE TURNOVER TIME OF RECOMBINER WATER AND BUILD-UP OF ^{137}Cs, ^{140}Ba, ^{141}Ce IN IT. Lazzarini, E.; Sangiust, V.; Terrani, M.; Terrani, S. (CESNEF, Milan). Energia Nucl. (Milan), 12: 593-7(Nov. 1965).

The build-up of fission products in the recombiner water of L54M reactor when it is operating at its maximum power was studied. The turnover time of the recombiner water was measured and the probabilities that ^{137}Xe, ^{140}Xe, and ^{141}Xe decay in it were also determined. An expression for these probabilities was obtained in function of the transport time of gaseous fission products from the core to the recombiner and of their transit time through the recombiner water. These time intervals were deduced from the probabilities, experimentally determined, that ^{137}Xe, ^{140}Xe, and ^{141}Xe decay in recombiner water. Values of 6.2 and 1.9 sec, respectively, were found. (auth)

10428 THE MULTI-PURPOSE RESEARCH REACTOR. Brandl, Josef. Energiewirtsch. Tagesfrag., 14: 407-11 (Sept. 1964). (In German).

The multi-purpose research reactor (MZFR) is briefly described including the reactor building, the reactor itself, the fuel elements, research devices, and safety devices. The use of the reactor for the production of electrical energy and for materials testing is described. The purpose of the MZFR and the results that can be obtained with it are summarized. (J.S.R.)

10429 THE RESEARCH REACTOR HERALD AT AWRE ALDERMASTON. McEnhill, J. J.; Rodgers, A. L.; Todd, M. C. J. (Atomic Weapons Research Establishment, Aldermaston, Eng.). J. Brit. Nucl. Energy Soc., 4: 344-53(Oct. 1965).

The modified HERALD reactor is briefly described including the experimental facilities. The programs of neutron-beam research and irradiation are summarized, and some specialized equipment associated with the experiments are described. (D.C.W.)

10430 REGULATION OF NEUTRON FLUX BY ^{16}N-ACTIVITY OF THE COOLANT IN THE RESEARCH REACTOR IN MUNICH. Sommer, M. Regelungstechnik, 13: 443-8(Sept. 1965). (In German).

An automatic reactor control system which yields a constant average neutron flux in the core by measuring the ^{16}N activity of the coolant is described. The ^{16}N is formed by an (n,p) reaction in the coolant water. Variations in activity resulting from changes in flow rate are calculated and graphed. The activities of ^{17}N, ^{19}O, ^{28}Al, ^{27}Mg, ^{24}Na, and ^{41}Ar are generally found not to interfere with the measurements, since they are either small or proportional to the ^{16}N activity. Thermal reactor effects and flux division in the core during buildup of ^{135}Xe poisoning are discussed. Relative neutron flux separation at constant ^{16}N activity for certain elements of the core and special arrangements to stabilize activity in these elements are described. (TCO)

10431 MEASUREMENT OF THE CONDUCTIVITY IN A SWIMMING POOL REACTOR. Petrucci, Giovanni. Rivoluzione Ind., No. 139, 61-2(July-Aug. 1965). (In Italian).

A circuit was perfected for the continuous measurement of conductivity in a swimming-pool reactor. The device proposed compensates for the effect of temperature on conductivity. It can thus unify the measurement to the value obtained at 20°C. The dimensional equations of the system are developed. (J.S.R.)

10432 A REACTOR CORE MODIFICATION TO ENHANCE BEAMS FOR THERMAL NEUTRON SPECTROMETERS. Bullock, J. B.; Daniels, E. A.; King, J. S. (Univ. of Michigan, Ann Arbor). 14p. (CONF-650602-75). ORINS. Gmelin, AED-CONF-65-125-98.

From American Nuclear Society 11th Annual Meeting, Gatlinburg, Tenn.

A method for reducing the fast neutron flux in the spectrometer beam ports of a light water pool reactor was investigated experimentally. The experiment consisted of installing a heavy water tank adjacent to the reactor core in a position which effectively converted two beam ports from a radial geometry to a tangential arrangement having a D_2O source region. The results show that a significant improvement in the quality of thermal beams from light water moderated reactors can be achieved by such an installation. The heavy water tank is small, inexpensive, and practical to operate. (J.F.P.)

10433 SWIMMING POOL TYPE REACTOR. Matsumoto, Masakichi (to Hitachi, Ltd.). Japanese Patent 1964-18480. Aug. 31, 1964. Filed Feb. 22, 1962.

An improved swimming-pool-type reactor is proposed, in which the radioactivity is considerably reduced near the surface of the water pool. Walls extending upward from the reactor core are installed in the water pool, thus separating this part of water from the other part of the water pool. The primary cooling water circulates only within this part; a heated-water layer is formed at the surface of this water. The water heated in the reactor core and containing recoil atoms and other radiations rises through this separated water, but is stopped near the surface water layer of higher temperature. The surface water layer has sufficient thickness to shield against the radioactivity. (NSA of Japan)

10434 SWIMMING-POOL TYPE REACTOR. Yamanouchi, Atsuo (to Hitachi, Ltd.). Japanese Patent 1964-23442. Oct. 21, 1964. Filed May 29, 1962.

In the swimming-pool type reactor proposed, a cylindrical compartment, at the bottom of which the reactor core is located, is installed in the pool with the top open to the atmosphere. The core cooling water is circulated through the compartment and an external heat exchanger; the water enters at the upper part of the compartment and leaves from the bottom. A warm water layer is formed by heaters, above the circulating water, to prevent the water heated in the core from rising to the water surface; warm water is supplied from outside to adjust the water level. Water colder than the entering coolant water is also drawn in, using part of the water circulated. Thus, the radiation level at the water surface is maintained very low. (NSA of Japan)

10435 SWIMMING-POOL TYPE REACTOR. Yamanouchi, Atsuo (to Hitachi, Ltd.). Japanese Patent 1964-23443. Oct. 21, 1964. Filed May 29, 1962.

In the water pool, a cylindrical compartment, at the bottom of which the reactor core is located, is installed with the top open to the atmosphere. The core cooling water is circulated through the compartment and an external heat exchanger; the water enters at the middle of the compartment and leaves from the bottom. The upper part of the water in the compartment is heated to form a warm layer there. Below this layer and above the level of the cooling water entrance, cold water is introduced to form a water layer of lower temperature than the coolant water entering the compartment, using part of the water from the said heat exchanger. This formation of two water layers brings about a low radiation level at the pool-water surface. (NSA of Japan)

10436 SEMI-CLOSED SWIMMING-POOL TYPE REACTOR. Yamanouchi, Atsuo (to Hitachi, Ltd.). Japanese Patent 1964-23444. Oct. 21, 1964. Filed May 29, 1962.

A cylindrical compartment, at the bottom of which the reactor core is located, is installed in the reactor pool with the top open to the atmosphere. The core cooling water is circulated through the compartment and an external heat exchanger; the water enters at the upper part of the compartment and leaves from the bottom. A warm water layer is formed at the surface of the compartment water by heating. Below this layer and above the level of the coolant water entrance is produced a cold water layer by means of a water conduit; the temperature difference between this layer and the top warm layer is so maintained as to provide a stable top layer. By means of these water layers, the convection of the cooling water in the compartment is limited under the cold water layer, because the rising warm water is cooled by the cold water layer. Thus, a low radiation level at the water surface is achieved. (NSA of Japan)

WASTE DISPOSAL AND PROCESSING

See also BIOLOGY AND MEDICINE — Ecology
CHEMISTRY — Radiochemistry
CHEMISTRY — Separation Processes and Procedures
HEALTH AND SAFETY

Refer also to abstracts 9029 and 9420.

10437 (NP-15662) THE EVAPORATION OF RADIOACTIVE WASTES BY SOLAR ENERGY. Report No. 1. Progress Report, December 1, 1963–August 31, 1964. Amarantos, A.; Hatzikakidis, A. (Democritus Nuclear Research Center, Athens (Greece)). Contract 224/RB. 18p. Dep. mn.

Field experiments with a flat plate collector (black body panels) as the heat source for a solar evaporator are described. From the field experiments conclusions were made in connection with the calculation and design of the evaporator. Reasons are given for choosing to heat the evaporator by heat exchangers instead of passing the wastes through the solar collectors. Calculations on the heat transfer were based on maximum values of received solar radiation. Two separate evaporating systems are described, and power and evaporating capacity for each were determined. (P.C.H.)

10438 (ORNL-3830, pp 96-139) WASTE TREATMENT AND DISPOSAL. (Oak Ridge National Lab., Tenn.).

Activities in a program to develop comprehensive waste management systems and to estimate costs of such systems are reported. Information is included on conversion of high-level wastes to solids, disposal of intermediate-level wastes, treatment of low-level wastes, and evaluation of waste management systems. (J.R.D.)

10439 (ORNL-3830, pp 285-98) ASSISTANCE PROGRAMS. (Oak Ridge National Lab., Tenn.).

Program activities are summarized on Eurochemic assistance, improvement of ORNL waste systems, disposal of high-level wastes in salt, disposal of wastes by hydrofracturing, development of high-level radiochemical laboratories, storage facilities for ^{233}U, testing filter-charcoal-bed systems, shielding for fission sources, and radiation testing of protective coatings. (J.R.D.)

10440 (ORNL-3863) PILOT PLANT DEMONSTRATION OF THE DECONTAMINATION OF LOW-LEVEL PROCESS WASTES BY A RECYCLE SCAVENGING-PRECIPITATION ION-EXCHANGE PROCESS. King, L. J.; Ichikawa, M. (Oak Ridge National Lab., Tenn.). Dec. 1965. Contract W-7405-eng-26. 39p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

It was demonstrated that low-radioactivity-level waste (LLW) can be treated by an improved scavenging-precipitation ion-exchange process to reduce strontium and cesium activity levels, by factors of about 1000 at a cost of 74.6¢ per 1000 gal in a 750,000-gal-per-day plant. The unit operations in the improved process are: passage through an alumina column; scavenging-precipitation; and ion exchange using CS-100 phenolic-carboxylic cation exchange resin. Process improvements included: an alumina column to remove phosphate; a high-capacity, 4-ft-dia agitated clarifier with a processing rate of 47 gal $hr^{-1}ft^{-2}$, contrasted to 27 for the older unit; and a recycle system. In this process, the strontium, cesium (sorbed on the clay), and other activities are removed from the system in a single stream, the clarifier sludge. The major part of the reduction in the cost of treatment is due to this modification. Overall decontamination factors for the modified system averaged 17, 11, 1200, 1400, 2.6, and 580, for gross beta, gross gamma, cesium, strontium, ruthenium, and rare earths, respectively, which reduced the concentrations of these radiation emitters to less than 2% of the 168-hr MPC_w for occupational exposure. Final treatment with an anion exchange column increased the ruthenium and cobalt decontamination factors to about 14 and 11, respectively. (P.C.H.)

10441 (ORNL-TM-1289) RECENT DEVELOPMENTS IN TREATING LOW AND INTERMEDIATE LEVEL RADIOACTIVE WASTE IN THE UNITED STATES. Blanco, R. E.; Alkire, G. J.; Davis, W. Jr.; Godbee, H. W.; Irish, E. R.; King, L. J.; Mercer, B. W.; Roberts, J. T.; Yee, W. C. (Oak Ridge National Lab., Tenn.). Dec. 1, 1965. Contract W-7405-eng-26. 52p. (CONF-651202-11). Dep. mn. CFSTI $3.00 cy, $0.50 mn.

From Symposium on Practices in the Treatment of Low and Intermediate Level Radioactive Waste, Vienna.

Recent research and development work in the treatment of low- and intermediate-level radioactive wastes is surveyed and brief economic evaluations of new treatment methods are included. The methods discussed include a scavenging-precipitation ion exchange process for treating low level waste; a scavenging-precipitation foam separation process; a process for treating process condensate wastes containing ammonia and organic materials; and a process for incorporation of intermediate level wastes in asphalt. (P.C.H.)

10442 (ORNL-TM-1343) FIXATION OF INTERMEDIATE LEVEL RADIOACTIVE WASTE IN ASPHALT: HOT-CELL TESTS. Goode, J. H. (Oak Ridge National Lab., Tenn.). Nov. 18, 1965. Contract W-7405-eng-26. 16p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Hot-cell tests on the fixation of intermediate-radioactivity-level waste (5 Curies/gal) in emulsified asphalt confirmed earlier successful nonradioactive and tracer tests of the process. Leaching, with static demineralized water, reached an apparent steady-state rate of about 2×10^{-4} g cm^{-2} day^{-1}, which is adequate for permanent disposal by burial in steel drums. Radiolytic-gas generation for five months, during which time the asphalt received an internal dose of about 1.2×10^7 rad, was not measurable. The success of these tests suggests that the process should be extended to include experiments with more different radioactive wastes. (auth)

10443 (STI/PUB/103) RADIOACTIVE WASTE DISPOSAL INTO THE GROUND. Safety Series No. 15. (International Atomic Energy Agency, Vienna (Austria)). 1965. 116p. IAEA: $2.50; S52,50; 15/-stg; F.Fr 10,-; DM 8,-.

Information is given on: site characteristics affecting ground disposal; chemical reactions and physical behavior of wastes in the ground; modes of release; evaluation of sites and methods for ground disposal; and standards and control techniques. 138 references are cited. (P.C.H.)

10444 (ORNL-tr-916) TREATMENT OF LIQUID WASTE CONTAINING ^{51}Cr. Hauang, E. J.; Yang, T. S. Translated for Oak Ridge National Lab., Tenn., from Ho Tsu K'o Hsueh, 4: 135-7(Feb. 1964). 5p. Dep. mn; JCL $1.10 fs, $0.80 mf.

A simple precipitation method of treating chromium-51 liquid waste is described. The waste is adjusted to pH 8 with 1N HCl, and is precipitated by adding $Pb(NO_3)_2$ aqueous solution. After these treatments the radioactivity of the filtrate is about background. (auth)

10445 TRAILED CONTAINER FOR RADIOACTIVE LIQUIDS. Bourdrez, J.; Leconnetable, J.; Rouanet, G. (CEN, Saclay, France). Bull. Inform. Sci. Tech. (Paris), No. 93, 27-40(May 1965). (In French).

A trailed shielded tank for loading, transporting, and discharging radioactive liquid wastes is described. The stainless steel container packed in a cast-lead shell can contain 4.500 liters of corrosive waste, the permissible radioactivity level is about ten curies β/γ per cubic meter. Equipment was studied to give an absolute safety for users; pumping up and out does not cause any risk of irradiation or liquid and atmospheric contamination. Tank characteristics are in accordance with the code for road traffic and with the specific rules applied to dangerous and radioactive materials conveyance; so it can be employed for transport outside the nuclear plant. (auth)

10446 ON THE APPLICATION OF FILTER AIDS FOR THE FILTRATION OF SLUDGES FROM THE DECONTAMINATION OF RADIOACTIVE EFFLUENTS. Levi, H. W. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Kerntechnik, 7: 485-90(Nov. 1965). (In German).

Some of the factors affecting the decontamination of radioactive sludges by filtration using filter aids were investigated. The distribution of the filter aid masses on predepositions and admixtures, aging of the precipitation, and addition of the filter aid before precipitation were the factors studied. The filter aids investigated were Fibra Flo, Filtercel, Celite 545, Celite 503, Hyflo-supercel, Sinofil, peat, sawdust, and vermiculite. Iron phosphate and calcium carbonate were the precipitating agents. Of the filter aids studied, Celite 545 and Celite 503 at a concentration of 4 g/l were optimum for the filtration of iron phosphate sludges. With 8 g/l sawdust, the filtration efficiency is significantly worse, to which must be compared however the lower cost and the possibility of volume reduction by burning. Fibra Flo offers no advantage because of its high price. In the filtration of $CaCO_3$, the addition of a filter aid is necessary only for the stabilization of the filter cooking. Filtercel in a concentration of 2 g/l is suitable for this. Predepositions of a part of the filter aid offers no advantages. Aging of the iron phosphate sludge and addition of the filter aid before precipitation do not affect the filtration characteristics. The decontamination factor for Sr was significantly modified by the choice of the filter aid neither in the case of iron phosphate nor calcium carbonate precipitation. (tr-auth)

10447 STUDIES ON THE TREATMENT OF RADIOACTIVE LIQUID WASTES BY FLOTATION METHOD. [PART] I. Koyanaka, Yoshio (Kyoto Univ.). Nippon Genshiryoku Gakkaishi, 7: 621-6(Nov. 1965). (In Japanese).

The removal of ^{141}Ce, ^{95}Zr, ^{95}Nb, ^{106}Ru, and ^{106}Rh from dilute aqueous solutions was investigated using the technique of soap flotation. Cerium nitrate, zirconium oxychloride, and ruthenium chloride were used as inactive carrier materials. From alkaline dilute solutions, 99.0% of the ^{141}Ce, 99.5% of the ^{95}Zr and ^{95}Nb, and 99.5% of the ^{106}Ru and ^{106}Rh were removed by soap flotation method using sodium oleate as flotation collector and ferric chloride as coprecipitating reagent. (auth)

10448 WASTE BURNING AT CHALK RIVER, CANADIAN INCINERATOR PLANT DEALS WITH 1200 lb/day. Nucl. Eng., 10: 472-3(Dec. 1965).

The procedures used for the incineration of low-activity waste (200 mR/hr maximum and about 5 mR/hr average) at Chalk River are described. The incinerator plant layout, construction, and operation are discussed. The handling of flue gas, using baghouse filters to remove fly ash, is described; the performance of absolute filters, originally intended for use besides the baghouse filters, was unsatisfactory. Instrumentation used is mentioned briefly. Results of testing and operation are discussed. Costs of construction and operation of the plant are considered. (M.J.T.)

10449 NATURALLY OCCURRING FIXATION OF ^{137}Cs ON SEDIMENTS OF LACUSTRINE ORIGIN. Lomenick, T. F.; Tamura, T. (Oak Ridge National Lab., Tenn.). Soil Sci. Soc. Amer., Proc., 29: 383-7(July-Aug. 1965).

The distribution of ^{137}Cs in sediments was studied in White Oak Lake, which formerly served as a final settling basin for contaminated waste water discharged from the Oak Ridge National Laboratory. Core samples of sediments were taken to a depth of 24 in., and assayed for ^{106}Ru, ^{60}Co, and ^{137}Cs. The most abundant radionuclide present in the sediment of Lacustrine origin is ^{137}Cs, with 704 C in the entire lake bed. Concentrations of ^{137}Cs on the sediment were observed to be as high as 77×10^{-3} $\mu C/g$. More than 80% of the ^{137}Cs is associated with the clay fraction of the material, which was found to be predominantly illite. Significant quantities of ^{137}Cs were removed from the material only by treatment with strong acids. Studies of several selected clays showed illite to have a high affinity for ^{137}Cs at levels of the same order of magnitude as those observed in lake bed sediment and that desorption is only accomplished after disruption of the lattice structure. The desorption behavior of the sediments and the corroborative behavior of the reference minerals are evidence that Cs in the sediment will not be leached by percolating ground water to any appreciable degree. However, movement of Cs can occur by erosion of the sediment. (BBB)

GENERAL AND MISCELLANEOUS

10450 (ALO–1) ALO STANDARD STRUCTURE FOR MANAGERIAL DATA. Neuman, Elmer A. (Albuquerque Operations Office (AEC), N. Mex.). Nov. 1965. 63p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

The ALO Standard Structure for managerial data and its actual and projected uses are described. The ALO Standard Structure is the framework for a broad management system covering many forms of managerial information for the multi-plant industrial complex, which is the weapons production system of the Albuquerque Operations Office of the USAEC. The Standard Structure is described, and information is given on the input operating budget, general plant projects and capital equipment budgets, analysis of complex major construction projects, and other uses of the Standard Structure. (P.C.H.)

10451 (BNL–8671) HYPERTENSION. Dahl, Lewis K. (Brookhaven National Lab., Upton, N. Y.). [1963]. Contract AT(30-2)-Gen-16. 16p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Evidence is briefly reviewed relating some nutritional elements and hypertension. In rats, hypertension can be produced by chronic excess salt (sodium chloride) consumption; the hypertension so produced can be ameliorated by increasing the dietary potassium or enhanced by other, unidentified, ions. Cadmium, without salt, appears capable of producing hypertension in female rats. In man, the evidence linking salt consumption to hypertension is circumstantial, the most suggestive of which is perhaps the fact that in certain communities with different levels of average salt consumption, the prevalence of hypertension increased, peri passu, with the average intake of salt. There is some circumstantial evidence to support the thesis that trace elements may be involved in human hypertension. (auth)

10452 (BNL–8682) RENAL CATABOLISM OF PANCREATIC RIBONUCLEASE AFTER INTRAVENOUS INJECTION IN RATS. Gregoire, Francine; Hughes, Walter L. (Brookhaven National Lab., Upton, N. Y.). Nov. 3, 1964. Contract AT(30-2)-Gen-16. 15p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Slices of rat kidney tissue, which contain exogenous ^{131}I-labeled ribonuclease as the result of the previous intravenous injection of this enzyme, were found to rapidly catabolize the enzyme in vitro, as determined by the release of radioactive iodide into the incubation medium. This process, which is oxygen dependent, can account for most of the intra-cellular enzyme and occurs in vitro at a rate only slightly slower than in vivo, indicating its physiological significance. (auth)

10453 (BNL–8683) RENAL UPTAKE OF PANCREATIC RIBONUCLEASE AFTER INTRAVENOUS INJECTION IN MICE AND RATS. Schultze, Brigitte; Gregoire, Francine; Hughes, Walter L. (Brookhaven National Lab., Upton, N. Y.). Nov. 3, 1964. Contract AT(30-2)-Gen-16. 30p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

The kidneys of mice and rats were found to accumulate ribonuclease (RNAse) labeled with either iodine (^{131}I or ^{125}I) or chromium (^{51}Cr) within minutes following intravenous injection. The radioactivity was localized in the apices of the cells of the proximal tubules. RNAse and iodine left the kidney during the next hour while chromium remained. This process is interpreted as one of glomerular filtration followed by tubular adsorption and catabolism of the protein, and can accommodate phenominal amounts of protein (at least 1 mg per mouse) in a few minutes so that it may represent the major catabolic mechanism for small plasma proteins. The effects of ureteral obstruction and of mercury poisoning on this process are described and the difference in the behavior of chromium and iodine labels is discussed. (auth)

10454 (BNL–9715) BIOLOGICAL BARRIERS AND MATERIAL TRANSFER. Nims, Leslie F. (Brookhaven National Lab., Upton, N. Y.). [1965]. Contract AT(30-2)-Gen-16. 44p. (CONF-660202–1). Dep. mn; CFSTI $2.00 cy, $0.50 mn.

From Head Injury Planning Committee Conference, Chicago.

A quantitative description of material transfer through biological barriers is discussed. The new description was developed from the principles of thermodynamics of irreversible processes. Physical meaning, mechanism, is given to the terms by employing the concepts of Newtonian physics. An elementary development of such a theory is described, and its application to the description of some of the observable phenomena in a model transfer system and a living cell is given. The theory re-emphasizes in a new way the importance of metabolic activity in determining distribution of substances in the various anatomical compartments of organized tissues. 54 references are cited. (P.C.H.)

10455 (BNWL–113–9) PLUTONIUM ABSTRACTS. VOLUME 5, NUMBER 9. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Oct. 29, 1965. Contract AT(45-1)-1830. 41p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Eighty-eight references with abstracts are given to journals and reports published from 1964 through Oct. 1965. The subjects covered include: biology and medicine; chemistry; health and safety; metallurgy; physics; and reactor technology. (P.C.H.)

10456 (COO–773–3) THE LUMINESCENCE OF OXINES AND METAL OXINATES. Bhatnagar, Dinesh C.; Forster, Leslie S. (Arizona Univ., Tucson. Dept. of Chemistry). [1964]. Contract AT(11-1)-773. 13p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Luminescence quantum yields for 8-quinolinols and metal oxinates were measured at 80°K where dissipative processes with appreciable activation energies were absent. When the quantum yield exceeded 0.05 the low-temperature limiting yield for neutral ligands was reached above 80°K. For anions and cations, the observed behavior was consistent with the presence of only one species in solutions of the ions. Attempts to observe phosphorescence were unsuccessful. The most striking regularity in the results was the effects of transition metal ions. One characteristic shared by the transition metal ions used, Mn(II), Cu(II), Ni(II), and Cr(III), was the presence of metal ion energy levels (d-d transitions) below the lowest singlet and triplet levels of the ligands. (P.C.H.)

10457 (COO-773-4) SCF CALCULATIONS OF α AND β-NAPHTHOL. Forster, Leslie S.; Nishimoto, Kichisuke (Arizona Univ., Tucson. Dept. of Chemistry. Mellon Inst., Pittsburgh, Pa.). [1964]. Contract AT(11-1)-773. 36p. Dept. mn. CFSTI $2.00 cy, $0.50 mn.

The Pariser-Parr-Pople method (SCF formalism) was applied to the computation of transition energies and intensities and charge distributions in the ground and excited states of α and β-naphthol. The calculated energy levels are in good agreement with experiment and fairly insensitive to the parameters employed. The transition intensities and charge distributions are sensitive to these parameters but qualitative trends may be correctly predicted. (auth)

10458 (COO–908–4) MOLECULAR COMPLEXES OF FLAVINS AND PHENOLS. I. ABSORPTION SPECTRA AND PROPERTIES IN SOLUTION. Fleischman, Darrell E.; Tollin, Gordon (Arizona Univ., Tucson. Dept. of Chemistry). [1964]. Contracts AT(11-1)-908; AF19(628)-414. 23p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Alloxazine and isoalloxazine derivatives such as lumichrome, FMN, and riboflavin yield highly colored solutions in strong acid with electron-rich phenols due to the formation of 1:1 charge transfer complexes between the phenol and the monoprotonated flavin. With very good donors, e.g.,

1,4-naphthalenediol or trimethylhydroquinone, similar complexes also form in neutral solution. The position of the charge transfer absorption band, in solution and in crystals of the complexes, varies with the donor properties of the phenol. EPR studies indicate the presence in acidic solution of low concentrations of the flavin semiquinone. (auth)

10459 (COO-908-5) MOLECULAR COMPLEXES OF FLAVINS AND PHENOLS. II. ELECTRICAL AND MAGNETIC PROPERTIES OF CRYSTALLINE SOLIDS. Ray, Ashoka; Guzzo, Anthony V.; Tollin, Gordon (Arizona Univ., Tucson. Dept. of Chemistry). [1963]. Contracts AT(11-1)-908; AF19(628)-414. 30p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

The electric and magnetic properties of single crystals of 1:1 charge transfer complexes of protonated flavins and phenols were investigated. The results indicate the following pattern for the electronic behavior of these materials. Charge carriers produced in the dark or by illumination are rapidly trapped and contribute to the electric conductivity by virtue of thermal release from trapping sites. The photocurrent is composed essentially equally of positive and negative carriers, with a rate limitation imposed by carrier migration. EPR results indicate that complete electron transfer processes can occur at lattice imperfection sites which are produced either during the crystallization process or by removal of solvent from already-formed crystals. The unpaired spins so produced behave as localized, doublet state, free radicals. (auth)

10460 (COO-908-6) MOLECULAR COMPLEXES OF FLAVINS AND PHENOLS. III. FACTORS INFLUENCING SPECTRA AND STABILITY. Fleischman, Darrell E.; Tollin, Gordon (Arizona Univ., Tucson. Dept. of Chemistry). [1964]. Contracts AT(11-1)-908; AF19(628)-414. 19p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Stability constants of a number of the complexes are presented, and correlations between complex stabilities, charge transfer band positions, and structures and electronic properties of the components were studied. The position of the charge transfer band of flavin-naphthalenediol complexes in acidic solution was found to be a monotonic function of the ionization potential of the donor as estimated from molecular orbital theory. Flavin-phenol complexes in neutral solution were found to have a 1:1 flavin-to-phenol ratio, while crystalline complexes obtained from such solutions displayed a 1:2 ratio. Stability constants of the complexes ranged roughly from 1 to 250. Neutral complexes were much more stable than acid complexes. Charge transfer did not contribute significantly to the stabilization of the acid complexes. (P.C.H.)

10461 (COO-908-7) MOLECULAR COMPLEXES OF FLAVINS AND PHENOLS. IV. SEMIQUINONE HYDROIODIDE COMPLEXES. Fleischman, Darrell E.; Tollin, Gordon (Arizona Univ., Tucson. Dept. of Chemistry). [1964]. Contracts AT(11-1)-908; AF19(628)-414. 17p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Studies showed that hydriodic acid can reduce isoalloxazine derivatives to the semiquinone level. Crystals of a solid material, probably an HI complex of the semiquinone hydriodide, containing approximately 100% unpaired spin content, can be obtained from such solutions. The semiquinone hydriodide was also found to form stable 1:1 complexes with various phenols. These may be isolated in crystalline form and also contain approximately 100% unpaired spin concentration. (auth)

10462 (COO-908-8) LIGHT-INDUCED SINGLE ELECTRON TRANSFER REACTIONS BETWEEN CHLOROPHYLL a AND QUINONES IN SOLUTION. III. ABSOLUTE QUANTUM YIELDS AS A FUNCTION OF TEMPERATURE AND SOLVENT. Tollin, Gordon; Chatterjee, Kumar K.; Green, Gisele (Arizona Univ., Tucson. Dept. of Chemistry). [1963]. Contract AT(11-1)-908. 20p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Absolute quantum yields for electron transfer were determined as a function of temperature in chlorophyll a-p-benzoquinone solutions in alcoholic solvents. These range, at high quinone concentrations, from about 0.1 electron per quantum absorbed at −10°C, up to about one electron per quantum at −110°C, and then down to zero electrons per quantum at −196°C. The yield appears to be determined principally by solvent viscosity and dielectric constant. A mechanism is proposed to account for this and comparisons with photosynthetic electron transfer are made. (auth)

10463 (COO-908-9) BIOLOGICAL POLYMERS RELATED TO CATECHOL. EPR AND IR STUDIES OF MELANIN, TANNIN, LIGNIN, HUMIC ACID AND HYDROXYQUINONES. Steelink, Cornelius; Tollin, Gordon (Arizona Univ., Tucson. Dept. of Chemistry). [1964]. Contract AT(11-1)-908. 18p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Melanin, lignin, tannin, and humic acid were found to exhibit similar paramagnetic properties. All of these biological polymers are stable organic free radicals. On conversion to the solid sodium salts, the polymers show a greatly enhanced radical content; this reaction is reversible. On the basis of studies of model compounds, hydroxyquinone and quinhydrone structures are proposed to account for these properties. (auth)

10464 (COO-920-5) DESORPTION OF He AND $^{14}CO_2$ FROM MICAS. Brandt, W. W.; Hattori, M.; Sreenivasan, V. R. (Illinois Inst. of Tech., Chicago. Dept. of Chemistry). [1964]. Contract AT(11-1)-920. 26p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

The rates of desorption of He from various micas were measured over an extended temperature range, using a sensitive small mass spectrometer. Below 500°C, the desorption probably involves many individual processes, each characterized by a different effective rate coefficient. As a consequence, the overall desorption rates are seemingly temperature independent. At elevated temperatures, the desorption rates correspond more closely to a single diffusion process, and are distinctly temperature dependent. On the basis of electron microscopic results and approximate estimates of the total amount of He evolved from various specimens, it was concluded that the high temperature process consists of the permeation of silicate sheets of a thickness intermediate between the individual structural parcels and the macroscopic sheets. The desorption of $^{14}CO_2$ was followed by a tracer technique and interpreted as a surface process. Approximate $^{14}CO_2$ transmission rates through mica sheets were measured and ascribed to flow through defect pores of submicroscopic dimensions. (auth)

10465 (COO-1020-8) CHELATION AND OLATION REACTIONS OF METAL IONS IN AQUEOUS SOLUTION. PART II. MIXED LIGAND CHELATES OF COPPER(II). Progress Report. L'Heureux, G.; Martell, Arthur E. (Illinois Inst. of Tech., Chicago. Dept. of Chemistry). 1964. Contract AT(11-1)-1020. 24p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Potentiometric studies of the interaction between the Cu(II) ion and various bidentate chelating agents are described. Evidence is given for the formation of Cu(II) chelates having a 1:1 molar ratio of Cu(II) with the respective ligands: 3,5-disulfopyrocatechol (Tiron), pyrocatechol, 3,6-disulfo-1,8-dihydroxynaphthalene, oxalic acid, 8-hydroxy-5-quinolinesulfonic acid, salicylic acid, and 5-sulfosalicylic acid. A study of the behavior of Cu(II) ion in the presence of equimolar concentrations of each of these ligands and α,α'-dipyridyl gave evidence for the formation of mixed ligand chelates containing 1:1:1 molar ratios of Cu(II) to dipyridyl to the secondary ligand. Formation constants were calculated, and probable structures of the metal complexes were deduced from the potentiometric data. (auth)

10466 (COO-1020-11) CHELATION AND OLATION REACTIONS OF METAL IONS IN AQUEOUS SOLUTION. PART VI. MIXED LIGAND COMPLEXES OF TRIETHYLENETETRAMINEHEXAACETIC ACID. Progress Report. Bohigian, T. A.; Martell, A. E. (Illinois Inst. of Tech., Chicago). 1964. Contract AT(11-1)-1020. 14p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

Mixed ligand chelates of triethylenetetraminehexaacetic acid (TTHA) were studied. Fe^{3+} and Cu^{2+} were used as the metal ions. The secondary ligands used were: disodium 1,2-dihydroxybenzene-3,5-disulfonate (Tiron); 5-sulfosalicylic acid (SSA); 8-hydroxyquinoline-5-sulfonic acid (HQS); and chromotropic salt (1,8-dihydroxynaphthalene-3,6-disodium sulfonate) (CS). Qualitative comparison of the potentiometric curves indicated that the Fe^{3+} ion forms much stronger TTHA mixed ligand chelates than does the Cu^{2+} ion. Results for each complex are discussed separately. (P.C.H.)

10467 (COO-1142-60) KINETICS OF THE DECOMPOSITION OF OXALIC ACID IN GLYCERINE. Haleem, M. A.; Yankwich, Peter E. (Noyes Lab. of Chemistry, Univ. of Illinois, Urbana). [1964]. Contract AT(11-1)-1142. 8p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

The decomposition of oxalic acid in 96% glycerine solution was studied over the range 88–121°C in a flow system. Non-stoichiometry previously observed at somewhat higher temperatures (and in a closed system) was not found, but it was discovered that the simple first-order character of the reaction altered suddenly at a degree of reaction which increased with increasing temperature. Formic acid was found to accelerate the decomposition; the effect of small amounts of added water was found to be very small, a difference from the behavior of the molten dihydrate. For the first-order region, the observed Arrhenius parameters are: $\underline{E} = 28.4 \pm 0.2$ kcal · mole^{-1}, and $\log(\underline{A}, \text{sec}^{-1}) = 12.3 \pm 0.1$; these and other activation parameters are in good agreement with those obtained for solvents expected to be kinetically inert toward oxalic acid and from the gas-phase reaction. (auth)

10468 (COO-1189-14) STRUCTURAL STUDIES BY NUCLEAR MAGNETIC RESONANCE. X. CONFORMATIONS OF ALIPHATIC ALDEHYDES. Karabatsos, Gerasimos J.; Hsi, Nelson (Michigan State Univ., East Lansing. Dept. of Chemistry). [1964]. Contract AT (11-1)-1189. 25p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

The spin-spin coupling constants between the aldehydic and α-protons of 18 substituted acetaldehydes were studied as function of temperature and solvent. The data are interpreted in terms of conformations II and III, whereby a single bond eclipses the carbonyl group. The coupling constants of monosubstituted acetaldehydes were found to be smaller than that of acetaldehyde and increased with increase in temperature. Increase in solvent polarity increased the coupling, except for phenylacetaldehyde, whose coupling decreased with increase in solvent polarity, and acetaldehyde, whose coupling showed only small variations. The relative stabilities of the various conformations of a substituted acetaldehyde can be qualitatively assessed from the dependence of its coupling on temperature. Special cases are also discussed. (P.C.H.)

10469 (COO-1198-229) EPITAXIAL GROWTH OF EVAPORATED COBALT FILMS. Honma, T.; Wayman, C. M. (Illinois Univ., Urbana). Nov. 1964. Contract AT(11-1)-1198. 36p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

The characteristics of cobalt films of initial purity 99.91% and 99.999% prepared by vacuum evaporation on various substrates were studied. Variables were substrate type (KCl, NaCl, and natural graphite), substrate temperature, vacuum during evaporation, and vacuum cleavage vs cleavage in air. Epitaxial fcc cobalt films could be obtained on KCl and NaCl, and semi-epitaxial hcp cobalt films could be obtained on graphite. The change in texture of the films upon annealing and their subsequent transformation behavior is discussed. (auth)

10470 (COO-1198-231) MASSIVE AND MARTENSITIC TRANSFORMATIONS IN β Cu–Ga ALLOYS. Saburi, T.; Wayman, C. M. (Illinois Univ., Urbana). Dec. 1964. Contract AT(11-1)-1198. 34p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

The massive and martensitic transformations in β Cu–Ga alloys were studied by optical microscopy, transmission electron microscopy, and diffraction. These types of transformations are distinct and do not merge into one another. An internal fine structure due to stacking faults was found in both the massive phase (ζ_m) and the martensite, but the origin of the faults is believed to be different in each case. The faults in the martensite are due to the lattice invariant or second shear of the phenomenological theory, while those in the ζ_m are probably growth and deformation faults arising from the transformation volume change. Evidence is presented for ordering in the β phase prior to transformation into martensite. The crystal structures of ζ_m, and β' and β_1' martensites are discussed. (auth)

10471 (NP-15720) DEVELOPMENTS AND PROGRAMS. (Commissariat a l'Energie Atomique, Paris (France)). June 1965. 62p. Dep. mn.

Plants, equipment, and research associated with the nuclear power program, isotope production, and health and safety in the CEA are reported. Operable and planned French reactors are listed. (P.C.H.)

10472 (NP-15721) UNITED KINGDOM ATOMIC ENERGY AUTHORITY ELEVENTH ANNUAL REPORT, APRIL 1, 1964–MARCH 31, 1965. (United Kingdom Atomic Energy Authority, London (England)). 102p. Dep. mn; BIS $1.60; HMSO 8s.

Information is given on: finance, accounts, and contracts; production plants and commercial activities; reactor development program; research on reactor systems; general research and development; plasma physics and fusion research; nuclear weapons and test detection; isotope production and research; health and safety; information services; relations with industry and universities; and international relations. (P.C.H.)

10473 (ORNL-P-882) CALCULATION OF PRODUCT YIELDS USING AN OPEN CARBONIUM ION MODEL FOR SOLVOLYSIS OF 3-PHENYL-2-BUTYL TOSYLATE. Collins, Clair J.; Lietzke, M. H.; Stoughton, R. W. (Oak Ridge National Lab., Tenn.). [1965]. Contract W-7405-eng-26. 9p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

The case for phenonium ions in the solvolyses of threo- and erythro-3-phenyl-2-butyl tosylates was evaluated. Previous results for product yields in the solvolysis of 3-phenyl-2-butyl tosylate (Cram, D. J., J. Am. Chem. Soc., 86: 3767 (1964)) were compared to a model for solvolysis by an open carbonium ion. (P.C.H.)

10474 (ORNL-TM-1321) A COMPARISON OF ALTERNATIVE COMPUTER CODES FOR THE DESIGN OF SALINE WATER CONVERSION PLANTS UTILIZING THE SINGLE-EFFECT, MULTI-STAGE FLASH-EVAPORATOR PROCESS. Easterday, R. J.; Griffith, W. L.; Keller, R. M.; Winsboro, R. B. (Oak Ridge National Lab., Tenn.). Jan. 1966. Contract W-7405-eng-26. 40p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Alternative computer programs for the process design of saline water conversion plants using the single-effect, multi-stage, flash-evaporation process were reviewed to determine areas where there are substantial differences in numerical approach or engineering assumptions. Comparisons of the numerical procedure utilized were made, and comparative results were calculated for typical design data. The major causes of the differences observed were pinpointed as differences in engineering approach. (auth)

10475 (ORNL-TM-1373) RESEARCH AND DEVELOPMENT PROBLEMS IN THE USE OF CONCRETE FOR EVAPORATOR SHELLS. Bender, M.; Gall, W. R.; Merkle, J. G.; Northup, T. E. (Oak Ridge National Lab., Tenn.). Jan. 1966. Contract W-7405-eng-26. 83p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

Preliminary studies of large desalination plants have indicated that substantial capital cost benefits may be realized through the use of concrete shells for evaporator installations. The feasibility of using concrete for this purpose hinges primarily on the ability of the concrete to retain adequate physical properties at elevated temperatures and to withstand thermal stresses caused by temperature gradients. The effects of seawater and distilled water on the surfaces of the concrete must also be determined for the elevated temperatures that will exist in certain portions of the evaporator. An experi-

mental program was developed to obtain the information needed to design and construct a prototype plant. The proposed program would cost approximately $4.5 million and extend over a period of four years. The objectives of this program and a survey of the problems anticipated in the design, construction, and operation of desalination plant evaporator shells constructed of concrete are presented. (auth)

10476 (SC-DC-65-1530) STRESS-CHARGE RELEASE RELATIONSHIPS FOR FERROELECTRIC CERAMICS. Ripperger, E. A.; Hart, Douglas (Texas Univ., Austin. Structural Mechanics Research Lab.). June 8, 1962. Contract AT(29-2)-621. 76p. Dep. mn; CFSTI $3.00 cy, $1.00 mn.

For Sandia Corp., Albuquerque, N. Mex.

The relationship between charge released, electrical load, and stress was studied for two ferroelectric materials, barium titanate (ceramic B) and lead zirconium titanate (52-48). Stresses that cover the range from zero to 10 kilobars were applied dynamically, in the axial mode, by allowing stress waves generated by an impact to pass through a specimen of the material. The stress applied was measured by the split pressure-bar technique. By properly correlating stress and charge measurements which were recorded as functions of time, stress-charge curves for a given electrical load were constructed. These curves show that the two materials investigated have a dynamic stress-charge relationship which is essentially the same as the static stress-charge relationship. The saturation stress, or the stress at which all the available charge is released was between 4 and 5 kilobars for both materials. Charge released was virtually independent of electrical load for pure ohmic loads between 8 and 1000 ohms. Electrical energy released increased almost directly with electrical load. A PZT in the Far Rhombohedral range (92-8) was also studied briefly. Charge release from this material seemed to be dependent on both rate of stress application and stress amplitude. (auth)

10477 (SCL-DC-65-130) A STUDY TO DETERMINE THE FEASIBILITY OF AUTOMATICALLY CORRECTING MACHINE POSITIONING ERRORS. Final Report, Phases I and II. (ACF Industries, Inc., Albuquerque, N. Mex.). Nov. 1965. Contract AT(29-1)-789. 62p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

For Sandia Corp., Livermore, Calif.

The feasibility of adjusting control tapes for numerically controlled machine tools or gages was investigated. The adjustments would be accomplished by computer post-processing techniques and would compensate for predetermined machine positioning errors. Both advantages and disadvantages are discussed. (M.O.W.)

10478 (TID-22492) STUDY OF THE HEMODYNAMIC CHARACTERISTICS OF THE PULMONARY CIRCULATION AND THE LEFT HEART BY MEANS OF RADIOCARDIOGRAPHY. Final Report. Donato, Luigi; Giuntini, C.; Maseri, A.; (and others) (Pisa Univ. (Italy)). Nov. 1965. Contract AT(30-1)-2648. 46p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

Developments and achievements of methodological, physiological, and clinical studies on radiocardiography (RCG) of pulmonary circulation and the left heart are reported. Methodological studies were concerned with injection of indicator, collimation of the counter, recording technique, and analytical procedures for evaluating the hemodynamic characteristics of the various vascular sections in the cardiopulmonary circulation. Physiological studies were concerned with determining the values of the relevant central hemodynamic parameters in normal and pathological conditions, validity of the obtained values, and their modifications in changing conditions following physiological, pharmacological, or pathological stimuli. Studies in patients were planned and pursued in view of assessing the usefulness of RCG for clinical investigation, and increasing understanding of the hemodynamic regulation of the cardiopulmonary circulation. (P.C.H.)

10479 (UCRL-12140) A MAGNETIC RESONANCE STUDY ON THE CITRITASE OF STREPTOCOCCUS DIACETILACTIS. Ward, Raymond L.; Srere, Paul A. (Lawrence Radiation Lab., Univ. of California, Livermore). Oct. 19, 1964. Contract W-7405-eng-48. 10p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

By the use of pulsed nuclear magnetic resonance techniques, the dissociation constant of Mn^{2+}-citritase was determined to be 0.4×10^{-4} M. This value is in agreement with the kinetically determined value. No evidence for ternary complex formation was found. The reaction would seem to be one that involves a metal-enzyme acting upon citrate (or acetate and oxaloacetate) rather than an enzyme acting upon a metal-citrate complex. (auth)

10480 (UCRL-12192) CONFORMATION CHANGES IN CITRATE-CONDENSING ENZYME. Srere, Paul A. (Lawrence Radiation Lab., Univ. of California, Livermore). Nov. 11, 1964. Contract W-7405-eng-48. 16p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

The four sulfhydryl groups of citrate-condensing enzyme will not react in aqueous solution with 5,5′-dithiobis(2-nitrobenzoate) (DTNB). When urea was added to the enzyme the conformation of the protein was changed in a way that permitted reaction between DTNB and protein SH. The rate of unfolding was first-order and dependent on urea concentration and temperature. The conformation change induced by urea could be slowed by the addition of substrates. (auth)

10481 (UCRL-12228) CONSTITUTIVE EQUATIONS INVOLVING CHRONOLOGICAL VARIABLES. Dong, Richard G. (Lawrence Radiation Lab., Univ. of California, Livermore). Dec. 8, 1964. Contract W-7405-eng-48. 21p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

A formulation of mechanical constitutive equations involving chronological variables in the form of hereditary functionals of functions of a hyperspace is presented. Included as special cases are viscoelastic, plastic, and viscoplastic constitutive equations. The formulation is based on the use of several chronological variables for independent chronologic ordering of events. Each chronological variable represents a different and independent memory mechanism. If time is the only chronological variable involved, then the constitutive equation is that for a viscoelastic material. (M.O.W.)

10482 (UCRL-12244-T) SURFACE FEATURES OF THE 50-S RIBOSOMAL COMPONENT OF ESCHERICHIA COLI. Hart, Roger G. (Lawrence Radiation Lab., Univ. of California, Livermore). Dec. 9, 1964. Contract W-7405-eng-48. 10p. Dep. mn. CFSTI $1.00 cy, $0.50 mn.

The 50-S ribosomal component isolated from Escherichia coli was examined by electron microscopy. In frozen-dried, tungsten-shadowed preparations, such particles were found to have surface features that can be interpreted as arising from a coiled nucleoprotein filament some 35 Å in diameter. A wire model was prepared, which is consistent with the observed features and is, therefore, believed to approximate the coil assumed by the nucleoprotein filament. (auth)

10483 (UCRL-13193) THE MECHANICAL BEHAVIOR OF FOAMED MATERIALS. I. A LITERATURE SURVEY. Report No. MD-65-4. Patel, M. R.; Finnie, I. (California Univ., Berkeley. Inst. of Engineering Research). May 1965. Contract W-7405-eng-48. 42p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

The mechanical properties and structure of foamed materials are reviewed. It was concluded that there is not yet a firm enough experimental background to support analytical attempts to predict foam properties from the knowledge of the properties of the base materials. 28 references are cited. (P.C.H.)

10484 (UCRL-14505(Pt.2)) THE CALCULATION OF TREATMENT SCHEDULES FOR CANCER CHEMOTHERAPY. PART II. Stuart, R. N.; Merkle, T. C. (Lawrence Radiation Lab., Univ. of California, Livermore). Dec. 7, 1965. Contract W-7405-eng-48. 26p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

The detailed structure of a model used to describe the growth of cell colonies is outlined, and results obtained when the model is applied to tumor growth are reported.

From calculations, it was concluded that in drug schedules calling for several successive exposures followed by a relatively long recovery period, considerable attention must be given to the relation between doubling time and tumor period or severe schedule resistance will be encountered. (P.C.H.)

10485 (UCRL–14543) GUN FACILITY FOR DYNAMIC IMPACT STUDIES OF EXPLOSIVE MATERIALS. Wasley, R. J.; O'Brien, J. F. (Lawrence Radiation Lab., Univ. of California, Livermore). Nov. 16, 1965. Contract W-7405-eng-48. 9p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

A gun facility is described that is designed and constructed to conduct both scientific and routine dynamic investigations (usually) with explosives. The system is inexpensive; dependable, and versatile and exhibits several unique features: the gun is not fixed and is allowed to recoil in a manner such that no rotation of the barrel occurs, projectiles may be either breech-loaded for precision experiments in vacuum or muzzle-loaded for certain experiments involving larger quantities of explosive and in which impact occurs some distance (several feet) downrange, the sample holder assembly, if used, is isolated from the gun itself by means of a thin flexible rubber diaphragm to reduce the coupling of elastic vibrations, and the specimen is separated from the muzzle tip to provide protection to the barrel. (auth)

10486 (WAPD-TM–554) THE EFFECT OF LOADING GEOMETRY ON THE FRACTURE TOUGHNESS OF BIAXIAL BRITTLE FRACTURE SPECIMENS. Romualdi, James P. (Carnegie Inst. of Tech., Pittsburgh, Pa.). Apr. 1964. Contract AT(11-1)-Gen-14. 45p. Dep. mn. CFSTI $2.00 cy, $0.50 mn.

For Bettis Atomic Power Lab., Pittsburgh, Pa.

Studies were made on the energy release rate (G) of the Westinghouse Biaxial Brittle Fracture Specimen. Two replicas of the specimen were made to scale; one of steel and the other of an aluminum alloy. The test phases on both replicas are described. The 10 to 1 steel replica permitted accurate and reproducible strain determination with the use of electric resistance strain gages. The maximum strains measured were on the order of 50×10^{-6} in. per in. Accordingly, unless more accurate data is made available in the future, it is suggested that the K-value (stress intensity factor) for the original (Manjoine) specimen is 3.37 P. Corresponding G_c values for the aluminum versions of the Manjoine specimen indicated a definite and severe loading geometry effect on G_c. (P.C.H.)

10487 (WERL–8844-9) FRACTURE TOUGHNESS TESTS ON A302B STEEL. Bush, A. J.; Stouffer, R. B. (Westinghouse Research Labs., Pittsburgh, Pa.). Oct. 1965. Contract AT(30-1)-3108. 60p. Dep. mn. CFSTI $3.00 cy, $0.75 mn.

Results of tests using Wedge Opening Loading specimens are given. Two sample sizes were used, 1X and 2X, in both the as-received and annealed conditions. The tests were conducted in the temperature range of –320 to 300°F. (W.L.G.)

10488 (Y–1487) ISOSTATIC HOT PRESSING. Levey, R. P. (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). June 9, 1965. Contract W-7405-eng-26. 69p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

An isostatic hot-pressing system was developed at 15,000 to 30,000 psi for large compacts. Process demonstrations illustrated the practicality of the system with eight-inch-diameter bars at 2000°C and twelve-inch-diameter bars at 1200°C. Furthermore, the data indicate that a modification of the existing equipment will provide capacity to forty inches in diameter at 2500°C and 30,000 psi. (auth)

10489 ATOMIC ENERGY LAW 1965—A YEAR IN REVIEW. Fischerhof, H. Atomwirtschaft, 10: 667-70(Dec. 1965). (In German).

The ratifications of international agreements on the legal aspects of nuclear energy and the acceptance of Euratom as an international institution are discussed. The legal aspects of atomic economy and weapons, radiation protection, insurance, and marine laws are summarized. (J.S.R.)

10490 TASKS AND POSITION OF THE FRENCH CEA. Vogel, W. (Univ. Goettingen, Ger.). Atomwirtschaft, 10: 677-81(Dec. 1965). (In German).

The structure, control, functions, and legal nature of the CEA are summarized and discussed. (J.S.R.)

10491 ATOMIC ENERGY IN CANADA. II. A COMPARISON WITH THE DEVELOPMENT IN GERMANY. Gray, J. L. Atomwirtschaft, 10: 685-8(Dec. 1965). (In German).

The relation of the AECL with private industry in Canada and in Germany is compared. The Canadian Atomic Energy Program is summarized. Possible future developments of atomic energy in Germany are indicated. (J.S.R.)

10492 GOVERNMENT PROMOTION OF NUCLEAR RESEARCH AND THE NUCLEAR ENGINEERING DEVELOPMENT IN GERMANY. Finke, Wolfgang. Energiewirtsch. Tagesfrag., 14: 402-6(Sept. 1964). (In German).

The federal expenditures in nuclear research in Germany are compared with the expenditures made by the other governments. The employment of people in nuclear research is indicated. The deficiencies in the government program are summarized and suggestions are made for the improvement of the German position. The five-year atomic program is described and the nuclear part of the program is considered in some detail. The studies being made on the development of a fast breeder reactor are indicated. (J.S.R.)

10493 RESEARCH CENTRES IN EUROPE. NO. 11. MOL. EuroNuclear, 2: 551-8(Nov. 1965).

Research at CEN near Mol, Belgium is reviewed. The BR-2 reactor complex, irradiation experiments in BR-2, beam experiments on BR-2, the Vulcain project, the Venus critical facility, BR-3 with the Vulcain core, the BR-1 experimental pile, plutonium laboratories, and fuel reprocessing are described. (M.C.G.)

10494 THE EURATOM RESEARCH PROGRAM AFTER ITS REFORM. Haunschild, H. H. Neue Tech., 5: 194-8(1965). (In German).

The Euratom research program is briefly reviewed. The financial position after the program change is summarized in tabular form. The modification of the research programs is described. Programs with increased expenditures are indicated along with those that were curtailed. The future plans of Euratom are briefly indicated. (J.S.R.)

10495 EUROPEAN AND INTERNATIONAL COLLABORATION IN THE AREA OF NUCLEAR RESEARCH. Baehr, Paul. Neue Tech., 5: 212-16(1965). (In German).

Bilateral and multilateral agreements in the area of nuclear research are briefly indicated. The emphasis is on the development of Euratom and Foratom. (tr-auth)

10496 REGIONAL DEVELOPMENT AND NUCLEAR ENERGY. Lecuyer, H. Neue Tech., 5: 223-9(1965). (In German).

The effects of nuclear energy on the industrial development of a region are discussed. The causes of industrial concentration and the diversification of energy sources are indicated. The conditions that lead to recourse in nuclear energy are summarized. The economic impact of a nuclear installation on a region is shown by a discussion of the effect of the Marcoule reactor. (J.S.R.)

10497 THE SUPPLY OF URANIUM TO BE DIFFICULT WITHIN 15 YEARS. Rivoluzione Ind., No. 139, 19-20 (July-Aug. 1965). (In Italian).

Within 15 years the presently known resources of U will begin to be depleted. This indicates the need for ore prospecting and for a rapid development of self-fertilizing reactors. The reactor types that can be used in the solution of this problem are indicated. (J.S.R.)

10498 LEAK VALVE. Green, J. T. (to U. S. Atomic Energy Commission). U. S. Patent 3,222,026. Dec. 7, 1965.

A leak valve is described in which the flow of fluid is controlled through a flexible tube by winding it about an expandable core so that expansion of the core, pneumatically, constricts the passage in the tube and regulates flow therethrough. (AEC)

10499 DATA PROCESSING. **Abraham, H. (to U. S. Atomic Energy Commission). U. S. Patent 3,222,670. Dec. 7, 1965.**

The conversion of a high-frequency analog signal into digital form by means of a slow-speed analog-to-digital converter through the use of cyclic synchronous analog and digital memories is described. In one embodiment of the method a single rotating drum is used to record the analog and digital signals, the analog signal is articulated, converted to digital signals, and recorded on a plurality of drum tracks sequentially. Provision is also made for simultaneous multiple recording of digital information in a plurality of tracks on the drum in one drum revolution. (AEC)

10500 DIFFUSION PUMP. **Milleron, Norman; Levenson, Leonard L. (to U. S. Atomic Energy Commission). U. S. Patent 3,224,665. Dec. 21, 1965.**

A fluid vaporizing and superheating element for a diffusion pump is described. The heating element consists of a plurality of parallel capillary channels extending above the surface of fluid to be heated and means for heating these channels. The channels may be formed by a plurality of concentric corrugated tapes separated by flat insulating tapes. (AEC)

10501 METHOD AND APPARATUS FOR MEASURING THE SPACE BETWEEN SURFACES OR OBJECTS. **McClung, R. W.; Dodd, C. V.; Allen, J. W.; Nance, R. A. (to U. S. Atomic Energy Commission). U. S. Patent 3,225,294. Dec. 21, 1965.**

A spacing gage was developed, which employs eddy currents to measure the spacing between objects of irregular cross section, or the internal diameter of tubular elements. (AEC)

10502 FLUID FLOW INTERLOCK. **Lucas, Luther R.; Miner, Claire R. (to U. S. Atomic Energy Commission). U. S. Patent 3,226,505. Dec. 28, 1965.**

A sensitive, durable, and fail-safe means for detecting a flow reduction in a fluid system was developed. The device consists of a venturi tube, which is transversely split near the most constricted point, with the downstream portion of the venturi mounted at the center of a flexible metal diaphragm and forming a flow aperture. In this arrangement, the diaphragm is drawn upstream when fluid flows through it. In case of a decrease in the flow, or in the event of blockage of the aperture, the diaphragm moves in the downstream direction to operate a control, alarm, or safety device. (AEC)

CORPORATE AUTHOR INDEX

This index contains entries for this period for all report literature and, in addition, for certain published literature items for which it is felt that a corporate approach is especially desirable, e.g., symposia, conference proceedings, and meetings.

Each entry under a corporate author is a shortened version of the title of the publication, followed by the *NSA* volume and abstract number. Report numbers are given in parentheses.

The phrase "Progress report" is abbreviated as "Prog. rpt.," permitting a more rapid and complete alphabetical arrangement of the titles without changing the location of the progress report titles in relation to the other titles.

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ACF INDUSTRIES, INC., ALBUQUERQUE, N. MEX.
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AEROJET-GENERAL NUCLEONICS, SAN RAMON, CALIF.
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AEROSPACE TECHNOLOGY DIV., LIBRARY OF CONGRESS, WASHINGTON, D. C.
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ä	becomes	ae
ö		oe
ø		oe
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SUBJECT INDEX

Main entries in this index are generally specific materials, things, and processes. These are followed by modifiers that describe the properties of, and processes applied to, the main entries.

The number preceding the colon is the *NSA* volume number, and the number following is the abstract number. The designation (R) following the abstract number indicates that the abstract is of a progress report; (P) indicates a patent; and (T) indicates a translation. Abstracts for reports other than progress reports carry no letter designation. References to report numbers, where appropriate, are included after the abstract number of the citation. Published literature (journal article or book) is identifiable by the absence of a report number.

The user should bear in mind that the ideas presented in the original literature, rather than key words, have been indexed. The indexers have tried to select what seemed the most probable and logical place to look for typical information. Since it is not possible to anticipate where a user would look for information, numerous cross references are included in cumulative indexes to assist him in his search.

Experience in using an index of this type will be the best guide in obtaining the desired information, and a consideration of synonymous or closely related terms will prove valuable.

Information must be so indexed as to be of the greatest use to the greatest number of users. This requires that a topic be indexed to headings that most specifically describe it and not ordinarily to the headings that describe its ultimate use, nor to the general class headings that include the specific headings. For example, information on the treatment of thyroid disease with I-131 would be indexed under Thyroid Gland and under Iodine Isotopes I-131, but not necessarily under Radiotherapy. A study of the effects of x radiation on hair would be indexed under both X Radiation and Hair. However, the information would not be indexed under the experimental animal, e.g., Rats, unless the report discusses the effects on rat hair as compared with the effect on the hair of other animals.

The broad, general class headings are used only for general information or for comprehensive reports or articles.

Subject Heading Styles

Generally, the direct form of subject entry is used rather than inverted headings, e.g., Amino Acids rather than Acids, Amino; Helium Isotopes He-4 rather than Helium—isotopes He-4 or Helium—He-4 isotopes. Note, however, that in some cases parenthetic modifying terms or inverted headings of the form Neutrons, Fast are used in preference to a direct entry that would result in the scattering of information. Organic compounds are usually entered in the index in the inverted form so that substituted compounds can be listed near the parent compound; e.g., Benzene, Bromo- rather than Bromobenzene. In general, the style of nomenclature used is that of Chemical Abstracts, except that some items listed in that publication as subheadings are elevated to form part of the main heading; e.g., Butyric Acid, Methyl Ester rather than Butyric Acid—methyl ester.

Alphabetization

Main headings are alphabetized word-by-word. A parenthetic qualifier following a main heading is disregarded in alphabetizing unless there are two or more headings identical except for the parenthetic qualifier, in which case the qualifier determines the order. Headings involving Greek letters are arranged as if the names of the letters were spelled out.

Examples:

M-Capture
  see Electron Capture
Magnesium
Magnesium Alloys
Manganese Fluorides
Manganese(II) Fluorides
Mesons
Mesons (π)
Mesons (ρ)
3-Pentanol, 2,4-Dimethyl-
2-Pentanol, 2-Methyl-
2-Pentanol, 4-Methyl-

Nomenclature of Inorganic Compounds

Inorganic compounds are indexed in the direct form, listing cations in the order of increasing valence in the case of polycationic salts of varying valence and in alphabetic order for polycationic salts in which all cations have the same valence; e.g., Sodium Aluminum Silicates and Potassium Sodium Sulfates.

Multicomponent Alloys and Other Systems

Multicomponent alloys, except well-known trade names, are indexed under a main heading in the form "element alloy" for each element in the alloy. The modifier begins with element symbols for each component arranged alphabetically as if the English name for the element were spelled out.

Example: Copper-Gold Alloy is indexed
  Copper Alloys
    Cu-Au...
  Gold Alloys
    Cu-Au...

Well-known alloys such as Zircaloy-2 are indexed directly to the trade name; cross references referring from each component of the alloy to the entry for the trade name appear in cumulative indexes.

Multicomponent systems of non-metallic elements are indexed in a manner similar to alloys except the main heading used contains the word "Systems" in place of "Alloys."

Example: Silicon–Tungsten Systems are indexed
  Silicon Systems
    Si-W...
  Tungsten Systems
    Si-W...

Multicompound systems and mixtures of compounds are indexed under the main heading for each component com-

pound; the modifiers begin with an alphabetical listing of compound formulas.

Example: Lead Titanate–Lead Zirconate is indexed
Lead Titanates
$PbTiO_3$-$PbZrO_3$...
Lead Zirconates
$PbTiO_3$-$PbZrO_3$...

A mixed system of compounds and elements is indexed using a combined form of the above conventions, e.g., a dispersion of copper and alumina would be indexed

Aluminum Oxides
Al_2O_3-Cu...
Copper Systems
Al_2O_3-Cu..

Physical States and Configurations of Materials

Specification of the physical state, if other than normal, or geometric configuration of the material is included in the modifying phrase, i.e., liquid metals would be indexed to the metal with "liquid" in the modifier, and carbon crucibles would be indexed to Carbon with "crucibles" appropriately placed in the modifier and also to Crucibles if appropriate.

Modifying Phrases

The modifiers appearing under a main heading are written specifically to describe the relation of the item being indexed to that main heading. The modifier, therefore, will generally contain more useful information about that relation than will a title or a phrase written to be used under every main heading assigned to the item. Effort is exerted to begin the modifier with the word judged to be of greatest use to the greatest number of users; this, however, does not obviate the need to consider all modifiers under the main heading(s) of interest.

Modifiers are usually intended to form a meaningful phrase when combined with the main heading. Some are intended to be read following the main heading, e.g., the entry Hydrogen—sorption by charcoal is read "hydrogen sorption by charcoal"; however, as a result of placing the important word first, many modifiers must be arranged for smooth reading, e.g., Formaldehyde—yields in radiolysis of ethyl ether, effects of deuterium on is read "effects of deuterium on formaldehyde yields in radiolysis of ethyl ether" and Uranium—crystal structure of, effect of cooling rate on allotropic transformations in is read "effect of cooling rate on allotropic transformations in crystal structure of uranium." Prepositions are sometimes omitted if no ambiguity results.

Special characters are added to modifiers in the field of physics; if the modifier does not establish the experimental or theoretical character of a reference, a symbol (E), (T), or (E/T) is placed immediately after the modifying phrase and before the journal reference number. The value of this identification has been established by the American Institute of Physics.

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Atomic Energy Commission Research Establishment, Risø. Available on exchange from the Library, Danish Atomic Energy Commission, Risø, Roskilde, Denmark. Also for sale by Jul. Gjellerup, Booksellers, 87 Sölvgade, København K., Denmark.

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Commissariat à l'Énergie Atomique. Inquiries for reports numbered 1-2199 should be addressed to Commissariat à l'Énergie Atomique, Service Central de Documentation, Centre d'Études Nucléaires de Saclay, Boite Postale No. 2, Gif-sur-Yvette (S. et O.), France. Reports numbered 2200 and above are available from La Documentation Francaise, 16 Rue Lord-Byron, Paris VIII, France.

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Eidgenössisches Institut für Reaktorforschung. "EIR" reports are available from Eidgenössiches Institut für Reaktorforschung, c/o Bibliothek, Würenlingen/Ag, Switzerland.

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Turkish Atomic Energy Commission. Copies are available free of charge from T.A.E.C., Çekmece Nuclear Research Center, P. O. Box 1, Airport, Istanbul, Turkey.

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If published proceedings are received after the receipt of individual papers, the complete proceedings will be abstracted and the abstract number will appear in this index with the base CONF number.

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2	20-8511	See NYO-2280-6
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7	20-9634	See D1-82-0484
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1	20-9185	See Y-KB-64
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16	20-9254	See UCRL-14270
17	20-9243	See AECL-2505
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CONF-651049–	**(IEEE Thermionic Conversion Specialist Conference, San Diego, Calif., Oct. 25–27, 1965)**	
1	20-10139	See LA-DC-7381
4	20-8883	See LA-DC-6135
CONF-651101	20-3647 20-9102	**(American Nuclear Society, Winter Meeting, Washington, D. C., Nov. 15–18, 1965) (Revised 11-8-65)**
49	20-10223	See ORNL-P-1787
CONF-651109–	**(1st Symposium on Accelerator Radiation Dosimetry and Experience, Upton, N. Y., Nov. 3–5, 1965)**	
17	20-8616	See BNL-9703
18	20-9172	See CONF-650616-28
CONF-651110–	**(American Society of Mechanical Engineers, Annual Winter Meeting, Chicago, Nov. 7–11, 1965)**	
22	20-9209	ORINS
CONF-651118–	**(American Physical Society, Gatlinburg, Tenn., Nov. 11–13, 1965)**	
2	20-9963	See BNL-9637
CONF-651202–	**(Symposium on Practices in the Treatment of Low and Intermediate Level Radioactive Waste, Vienna, Dec. 6–10, 1965)**	
11	20-10441	See ORNL-TM-1289
CONF-651203–	**(14th Annual Symposium on Wire and Cable, Atlantic City, Dec. 1–3, 1965)**	
1	20-9889	See EGG-1183-1192
CONF-651204–	**(Electrochemical Society Conference, Los Angeles, Dec. 4, 1965)**	
1	20-8886	See SC-DC-65-1792
CONF-651208–	**(Conference on Lymph and Lymphatic System, New Orleans, Dec. 12–14, 1965)**	
1	20-8617	See BNL-9801
CONF-660202–	**(Head Injury Planning Committee Conference, Chicago, Feb. 7–9, 1966)**	
1	20-10454	See BNL-9715

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CONF-660203–	**(National Topical Meeting on Reactor Physics in the Resonance and Thermal Regions, San Diego, Calif., Feb. 7–9, 1966)**	
2	20-9938	See BNL-9770
4	20-9944	See RPI-328-44
CONF-660204–	**(American Nuclear Society Meeting, San Diego, Calif., Feb. 7–9, 1966)**	
2	20-9943	See ORNL-P-1885
CONF-660301–	**(IEEE International Convention, New York, Mar. 21–25, 1966)**	
1	20-9223	See LA-DC-7502
CONF-660401–	**(American Meteorological Society, American Geophysical Union, Annual Joint Meeting, Washington, D. C., Sept. 19, 1966)**	
1	20-9168	See BNWL-SA-429
COO–		
7-0359	20-9726	Nucl. Phys., 77: 394-400(1966)
7-0364	20-9726	Nucl. Phys., 77: 394-400(1966)
119-233	20-8544	Dep. mn; CFSTI $4.00 cy, $0.75 mn
427-42	20-9709	Dep. mn. CFSTI $1.00 cy, $0.50 mn
773-3	20-10456	Dep. mn. CFSTI $1.00 cy, $0.50 mn
773-4	20-10457	Dep. mn. CFSTI $2.00 cy, $0.50 mn
908-4	20-10458	Dep. mn. CFSTI $1.00 cy, $0.50 mn
908-5	20-10459	Dep. mn. CFSTI $2.00 cy, $0.50 mn
908-6	20-10460	Dep. mn. CFSTI $1.00 cy, $0.50 mn
908-7	20-10461	Dep. mn. CFSTI $1.00 cy, $0.50 mn
908-8	20-10462	Dep. mn. CFSTI $1.00 cy, $0.50 mn
908-9	20-10463	Dep. mn. CFSTI $1.00 cy, $0.50 mn
920-5	20-10464	Dep. mn; CFSTI $2.00 cy, $0.50 mn
1020-7	20-8879	Dep. mn. CFSTI $1.00 cy, $0.50 mn
1020-8	20-10465	Dep. mn. CFSTI $1.00 cy, $0.50 mn
1020-10	20-8880	Dep. mn. CFSTI $1.00 cy, $0.50 mn
1020-11	20-10466	Dep. mn. CFSTI $1.00 cy, $0.50 mn
1142-60	20-10467	Dep. mn; CFSTI $1.00 cy, $0.50 mn
1189-16	20-8963	Dep. mn. CFSTI $1.00 cy, $0.50 mn
1189-14	20-10468	Dep. mn; CFSTI $1.00 cy, $0.50 mn
1195-40	20-9757	Phys. Lett., 19: 706-8(1966)
1198-229	20-10469	Dep. mn; CFSTI $2.00 cy, $0.50 mn
1198-231	20-10470	Dep. mn; CFSTI $2.00 cy, $0.50 mn
1198-268	20-9520	J. Phys. Chem. Solids, 26: 1973-5(1965)
1198-316	20-9931	Phys. Rev. Lett., 16: 101-4(1966)
1248-4	20-8811	Dep. mn. CFSTI $3.00 cy, $0.75 mn
1249-3	20-8628	Dep. mn. CFSTI $1.00 cy, $0.50 mn
1367-1	20-9571	Dep. mn; CFSTI $1.00 cy, $0.50 mn
1400-4	20-8698	Radiat. Bot., 5: 475-92(1965)
CRGP–	**(Canadian)**	
1225	20-9243	See AECL-2505
D–	**(Misc.)**	
1-82-0484	20-9634	
DASA–	**(Misc.)**	
1708	20-9656	See GA-6699
DATDC–	**(Non-AEC)**	
28	20-9136	See AD-626380
34	20-9137	See AD-626382
DOCKET	**(Misc.)**	
50-220	20-10380	See TID-22438
DP–		
990	20-9420	Dep. mn. CFSTI $2.00 cy, $0.50 mn
994	20-9572	Dep. mn. CFSTI $1.00 cy, $0.50 mn
DPSPU–		
64-30-17A	20-9267	Health Phys., 12: 99-101(1966)
DUBNA REPORTS	**(Russian)**	
See JINR (Russian)		
EANDC-US–	**(European-American Nuclear Data Committee)**	
79(U)	20-9981	See WASH-1064
ECOM–	**(Non-AEC)**	
2639	20-9220	CFSTI $1.00 cy, $0.50 mn
EGG–		

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1183-1192	20-9889	Dep. mn; CFSTI $2.00 cy, $0.50 mn
1183-2043	20-9695	Dep. mn; CFSTI $2.00 cy, $0.50 mn
ER–	**(Misc.)**	
6497	20-9698	See NASA-CR-54752
EUR–	**(European Atomic Energy Community)**	
2327	20-9441	See EURAEC-1352
2330	20-10351	See EURAEC-1355
2344	20-10371	See EURAEC-1381
2385	20-9573	See EURAEC-1455
2387	20-9574	See EURAEC-1458
2394	20-9443	See EURAEC-1473
2474.e	20-10370	Dep. mn
2513.f	20-10425	Dep. mn
2536.e	20-9939	Dep. mn
2547.e	20-10270	Dep. mn
2577.i	20-9248	Dep. mn
2584.e	20-9940	Dep. mn
2589.e	20-8508	Dep. mn
2653	20-9421	See EURAEC-1486
2670	20-9442	See EURAEC-1518
EURAEC–		
1352	20-9441	Dep. mn. CFSTI $2.00 cy, $0.50 mn
1355	20-10351	Dep. mn; CFSTI $1.00 cy, $0.50 mn
1381	20-10371	Dep. mn; CFSTI $1.00 cy, $0.50 mn
1455	20-9573	Dep. mn. CFSTI $3.00 cy, $0.50 mn
1458	20-9574	Dep. mn. CFSTI $2.00 cy, $0.50 mn
1473	20-9443	Dep. mn. CFSTI $1.00 cy, $0.50 mn
1483	20-9113	See BAW-3238-10
1486	20-9421	Dep. mn; CFSTI $1.00 cy, $0.50 mn
1518	20-9442	Dep. mn. CFSTI $1.00 cy, $0.50 mn
1531	20-9496	See NCSC-2663-19
1533	20-10291	See GEAP-4967
EURFNR–	**(Non-AEC)**	
3F	20-10384	Dep. mn; CFSTI $2.00 cy, $0.50 mn
10F	20-10385	Dep. mn; CFSTI $2.00 cy, $0.50 mn
12F	20-10332	Dep. mn; CFSTI $2.00 cy, $0.50 mn
FTD-TT–	**(Non-AEC)**	
65-767	20-9856	For translation see AD-622422
GA–	**(Misc.)**	
6031	20-9446	Carbon, 3: 167-74(1965)
6050	20-9447	Carbon, 3: 201-11(1965)
6152	20-8827	Dep. mn; CFSTI $3.00 cy, $0.75 mn
6296	20-10372	Dep. mn; CFSTI $2.00 cy, $0.50 mn
6565	20-9023	See CONF-650707-19
6635	20-10271	Dep. mn. CFSTI $4.00 cy, $1.00 mn
6699	20-9656	
GAMD–	**(Misc.)**	
6674	20-10373	Dep. mn; CFSTI $3.00 cy, $0.75 mn
6692	20-9941	Dep. mn. CFSTI $1.00 cy, $0.50 mn
6745	20-10374	Dep. mn. CFSTI $1.00 cy, $0.50 mn
GEAP–	**(Misc.)**	
4967	20-10291	Dep. mn. CFSTI $3.00 cy, $0.50 mn
GEMP–	**(Misc.)**	
54A	20-9378	Dep. mn. CFSTI $3.00 cy, $0.75 mn
HASL–		
166	20-9173	Dep. mn; CFSTI $2.50 cy, $0.75 mn
HW-SA–		
3603	20-8549	Dep. mn. CFSTI $1.00 cy, $0.50 mn
3777	20-8881	Dep. mn. CFSTI $1.00 cy, $0.50 mn
3886	20-8566	Health Phys., 12: 7-13(1966)
IAE–	**(Non-AEC)**	
876	20-9686	Dep. mn
878	20-9965	Dep. mn
885	20-9966	Dep. mn
940	20-9967	Dep. mn
949	20-9300	Dep. mn
950	20-9696	Dep. mn
IBJ–	**(Polish)**	
See INR		

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IC–	**(Misc.)**	
65/82	20-9873	Dep. mn
65/83	20-9790	Dep. mn
65/86	20-9371	Dep. mn
65/87	20-9710	Dep. mn
65/91	20-9791	Dep. mn
IDO–		
14658	20-9043	Dep. mn. CFSTI $2.00 cy, $0.50 mn
17103	20-9301	Dep. mn. CFSTI $3.00 cy, $0.75 mn
17125	20-9942	Dep. mn. CFSTI $3.00 cy, $0.75 mn
IFJ–	**(Polish)**	
See INP		
IMR–	**(Non-AEC)**	
616/IXa/PP	20-10134	Dep.
623/VII/PH	20-9711	Dep.
642/XVIII/PP	20-9221	Dep.
INSJ–	**(Japanese)**	
89	20-9968	Dep. mn
IONAC–		
5002(Suppl.)	20-8836	See TID-22511(Suppl.)
IPPJ–	**(Japanese)**	
37	20-10135	Dep. mn
40	20-10136	Dep. mn
41	20-10137	Dep. mn
42	20-9657	Dep. mn
43	20-10138	Dep. mn
IS–		
983	20-8882	Dep. mn; CFSTI $2.00 cy, $0.50 mn
1174	20-9531	Trans. Met. Soc. AIME, 233: 2063-9(1965)
1188	20-8993	J. Am. Chem. Soc., 87: 5558-65(1965)
1207	20-9073	Talanta, 13: 123-8(1966)
IS-T–		
38	20-9658	Dep. mn; CFSTI $4.00 cy, $1.00 mn
JEN–	**(Spanish)**	
161-DF/I-50	20-9712	Dep. mn
JINR–	**(Russian)**	
P-2386	20-9969	Dep. mn
P-2395	20-9610	Dep. mn
JPL-TR–	**(Non-AEC)**	
32-818	20-9492	
32-827	20-9493	
K–		
1638	20-8828	Dep. mn. CFSTI $2.00 cy, $0.50 mn
KR–	**(Norwegian)**	
101	20-10323	Dep. mn
KRB–	**(German)**	
1965/2	20-10381	See TID-22467
LA–		
3318	20-9222	Dep. mn; CFSTI $1.00 cy, $0.50 mn
3383	20-9970	Dep. mn. CFSTI $2.00 cy, $0.50 mn
3407	20-9835	Dep. mn. CFSTI $2.00 cy, $0.50 mn
3413	20-9575	Dep. mn. CFSTI $1.00 cy, $0.50 mn
LA-DC–		
6135	20-8883	Dep. mn; CFSTI $1.00 cy, $0.50 mn
6559	20-9599	Dep. mn; CFSTI $1.00 cy, $0.50 mn
6827	20-8743	Dep. mn; CFSTI $6.00 cy, $1.25 mn
6833	20-9494	Dep. mn; CFSTI $1.00 cy, $0.50 mn
6869	20-9092	Dep. mn; CFSTI $1.00 cy, $0.50 mn
7236	20-9839	Cryogenics, 5: 245-7(1965)
7345	20-10074	Physics, 2: 141-9(1965)
7381	20-10139	Dep. mn; CFSTI $1.00 cy, $0.50 mn
7488	20-8918	J. Am. Chem. Soc., 87: 5803-4(1965)
7502	20-9223	Dep. mn; CFSTI $1.00 cy, $0.50 mn
7553	20-9864	Phys. Rev. Lett., 16: 138-42(1966)

Report No.	Abstract No.	Availability
LF–		
28	20-8629	Dep. mn; CFSTI $3.50 cy, $1.50 mn
LMSC–	(Misc.)	
A764749	20-10417	See NAA-SR-Memo-11635
MATT–		
340	20-10170	J. Nucl. Energy: Pt. C, 7: 589-92(1965)
391	20-10140	Dep. mn. CFSTI $3.00 cy, $0.75 mn
428	20-10141	Dep. mn. CFSTI $3.00 cy, $0.75 mn
MIT–	(Misc.)	
65TR53	20-9095	See NYO-3237-3
2098-201	20-9971	Dep. mn. CFSTI $2.00 cy, $0.50 mn
MLM–		
1285(tr)	20-9982	Dep. mn; JCL $2.60 fs, $1.01 mf
MPI-PAE–	(German)	
P1.12/65	20-10142	Dep. mn
P1.13/65	20-10143	Dep. mn
NAA-SR–		
9339	20-10272	Dep. mn; CFSTI $3.00 cy, $1.25 mn
11191	20-9495	Dep. mn; CFSTI $2.00 cy, $0.50 mn
11231	20-9972	Dep. mn. CFSTI $3.00 cy, $0.75 mn
11326	20-9422	Dep. mn. CFSTI $2.00 cy, $0.50 mn
11650	20-10273	Dep. mn. CFSTI $6.00 cy, $1.25 mn
NAA-SR-Memo–		
10913	20-9357	Dep. mn. CFSTI $3.00 cy, $0.50 mn
11433	20-10377	Dep. mn; CFSTI $1.00 cy, $0.50 mn
11607	20-10378	Dep. mn; CFSTI $2.00 cy, $0.50 mn
11635	20-10417	Dep. mn; CFSTI $7.00 cy, $1.75 mn
NASA-CR–	(Misc.)	
349	20-9697	CFSTI $2.00 cy, $0.50 mn
353	20-8884	CFSTI $2.00 cy, $0.50 mn
54716	20-10418	
54735	20-9423	
54752	20-9698	
54844	20-9424	
NASA-TN–	(Misc.)	
D-3051	20-10144	CFSTI $1.00 cy, $0.50 mn
D-3164	20-10145	CFSTI $3.00 cy, $0.75 mn
D-3194	20-9127	CFSTI $2.00 cy, $0.50 mn
D-3197	20-9128	CFSTI $1.00 cy, $0.50 mn
NCSC–	(Misc.)	
2663-19	20-9496	Dep. mn; CFSTI $2.00 cy, $0.50 mn
NIRL-R–	(British)	
89	20-9611	Dep. mn. BIS $1.00. HMSO 5s.
NP–	(AEC File No. for Non-AEC Reports)	
15580	20-10276	Dep. mn
15634	20-8831	
15662	20-10437	Dep. mn
15665	20-9836	
15687	20-10426	Dep. mn
15692	20-10221	Dep. mn
15699	20-9890	
15700	20-9891	
15717	20-9372	
15720	20-10471	Dep. mn
15721	20-10472	Dep. mn; BIS $1.60; HMSO 8s.
15725	20-9497	
15763	20-9174	Dep. mn
15768	20-10146	Dep. mn
15770	20-9178	
15780	20-8832	Dept. of Mines and Technical Surveys, Ottawa $1.25
15787	20-9713	Dep. mn
15790	20-9612	Dep. mn
15792	20-9714	Dep. mn
15795	20-10147	Dep. mn
15816	20-9973	Dep. mn
15817	20-9892	Dep. mn
NRL–	(Misc.)	
6293	20-9485	See AD-623567
6341	20-9179	Dep. mn. CFSTI $1.00 cy, $0.50 mn
NYO–		
755-2	20-9361	Dep. mn; CFSTI $4.00 cy, $0.75 mn
2280-6	20-8511	Dep. mn; CFSTI $2.00 cy, $0.50 mn
2471-11	20-10230	Dep. mn; CFSTI $4.00 cy, $1.00 mn
3100-1	20-10150	See TID-22429
3216-1	20-8533	Dep. mn; CFSTI $1.00 cy, $0.50 mn
3228-6	20-9498	Dep. mn; CFSTI $1.00 cy, $0.50 mn
3237-3	20-9095	Dep. mn; CFSTI $4.00 cy, $0.75 mn
3369-6	20-8833	Dep. mn; CFSTI $1.00 cy, $0.50 mn
3399-43	20-9792	Dep. mn; CFSTI $1.00 cy, $0.50 mn
3399-44	20-9793	Dep. mn; CFSTI $1.00 cy, $0.50 mn
3510-14	20-9250	Dep. mn; CFSTI $3.00 cy, $0.75 mn
3578-2	20-10148	Dep. mn. CFSTI $1.00 cy, $0.50 mn
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3826	20-9358	Dep. mn. CFSTI $2.00 cy, $0.50 mn
3830	20-8812	Dep. mn; CFSTI $7.00 cy, $1.50 mn
3852	20-10222	Dep. mn. CFSTI $1.00 cy, $0.50 mn
3863	20-10440	Dep. mn. CFSTI $2.00 cy, $0.50 mn
3878	20-9576	Dep. mn. CFSTI $3.00 cy, $0.75 mn
3895	20-9874	Dep. mn; CFSTI $3.00 cy, $0.50 mn
3898	20-9425	Dep. mn; CFSTI $6.00 cy, $1.25 mn
ORNL-P–	(Misc.)	
882	20-10473	Dep. mn. CFSTI $1.00 cy, $0.50 mn
1008	20-9380	Dep. mn. CFSTI $2.00 cy, $0.50 mn
1026	20-10232	J. Phys. Chem. Solids, 26: 1689-94(1965)
1164	20-9030	Int. J. Appl. Radiat. Isotop., 16: 747-9(1965)
1168	20-8849	Talanta, 13: 43-8(1966)
1406	20-8667	Genetics, 52: 1329-34(1965)
1451	20-8666	Genetics, 52: 1279-94(1965)
1515	20-9666	Phys. Lett., 19: 14-15(1965)
1524	20-10251	Phys. Rev., 141: 750-7(1966)
1787	20-10223	Dep. mn; CFSTI $1.00 cy, $0.50 mn
1790	20-10061	Phys. Lett., 19: 673-5(1966)
1818	20-10071	Phys. Rev. Lett., 16: 28-30(1966)
1820	20-8534	Dep. mn; CFSTI $2.00 cy, $0.50 mn
1833	20-10065	Phys. Lett., 19: 682-3(1966)
1885	20-9943	Dep. mn. CFSTI $2.00 cy, $0.50 mn
ORNL-TM–		
1196	20-10224	Dep. mn. CFSTI $3.00 cy, $0.75 mn
1289	20-10441	Dep. mn. CFSTI $3.00 cy, $0.50 mn
1309	20-9180	Dep. mn. CFSTI $1.00 cy, $0.50 mn
1321	20-10474	Dep. mn; CFSTI $2.00 cy, $0.50 mn
1329	20-10413	Dep. mn. CFSTI $4.00 cy, $0.75 mn
1343	20-10442	Dep. mn. CFSTI $1.00 cy, $0.50 mn
1373	20-10475	Dep. mn. CFSTI $3.00 cy, $0.75 mn
ORNL-tr–		
916	20-10444	Dep. mn; JCL $1.10 fs, $0.80 mf
922	20-9506	Dep. mn; JCL $1.60 fs, $0.80 mf
PAN–	(Polish)	(This series of reports was terminated in 1965. Subsequent reports are identified by the code INR.)
PATENTS	(British)	(4s. 6d. each, U. K. Patent Office)
1,010,020	20-8958	
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1,011,348	20-9477	
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1,012,162	20-9478	
1,012,262	20-10300	
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1,198,462	20-9294	
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1964-10449	20-9623	
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1964-12694	20-10305	
1964-12697	20-9625	
1964-12698	20-9626	
1964-12699	20-9627	
1964-14094	20-9481	
1964-14590	20-9482	
1964-14727	20-9309	
1964-14828	20-9024	
1964-15090	20-10306	
1964-16050	20-9355	
1964-16147	20-10307	
1964-16149	20-10308	
1964-18445	20-9295	
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1964-18480	20-10433	
1964-18482	20-10349	
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1964-18493	20-9629	
1964-18695	20-9630	
1964-19138	20-9631	
1964-19139	20-9632	
1964-21415	20-10310	
1964-21416	20-10311	
1964-21417	20-10410	
1964-21573	20-9296	
1964-21574	20-9297	
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PPAD–		
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PUC–		
937-171	20-9974	Dep. mn; CFSTI $3.00 cy, $0.75 mn
937-174	20-9975	Dep. mn; CFSTI $6.00 cy, $1.25 mn
PWAC–	**(Misc.)**	
468	20-10419	Dep. mn; CFSTI $3.00 cy, $0.75 mn
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RFR–	**(Swedish)**	
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65-13	20-9302	
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4530(Rev.)	20-9164	Dep. mn; CFSTI $2.00 cy, $0.50 mn
RPI–	**(Misc.)**	
328-44	20-9944	Dep. mn. CFSTI $1.00 cy, $0.50 mn
RPP-H–	**(British)**	

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5	20-9787	See CONF-650222-1
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RT-FI-	**(Italian)**	
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(65)34	20-9225	Dep. mn
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(65)13	20-10330	Dep. mn
SC-DC-		
65-1530	20-10476	Dep. mn; CFSTI $3.00 cy, $1.00 mn
65-1792	20-8886	Dep. mn; CFSTI $2.00 cy, $0.50 mn
65-1893	20-9091	Dep. mn. CFST $3.00 cy, $0.75 mn
SC-DR-		
65-568	20-9096	Dep. mn. CFSTI $3.00 cy, $0.75 mn
SC-R-		
65-1023	20-9129	Dep. mn; CFSTI $1.00 cy, $0.50 mn
SC-T-		
65-0773	20-10153	Dep. mn; JCL $1.60 fs, $0.80 mf
SC-TM-		
65-397	20-9181	Dep. mn. CFSTI $2.00 cy, $0.50 mn
65-577	20-9226	Dep. mn. CFSTI $1.00 cy, $0.50 mn
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SGAE-G-	**(Austrian)**	
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SLAC-		
52	20-9251	Dep. mn. CFSTI $3.00 cy, $0.75 mn
SLAC-PUB-		
121	20-9252	Dep. mn; CFSTI $2.00 cy, $0.50 mn
148	20-9794	Dep. mn; CFSTI $2.00 cy, $0.50 mn
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SRRC-RR-	**(Misc.)**	
65-96	20-10149	CFSTI $2.00 cy, $0.50 mn
STI-PUB-	**(International Atomic Energy Agency)**	
96(Vol.1)	20-8749	IAEA $15.00
103	20-10443	IAEA: $2.50; S52,50; 15/-stg; F.Fr 10,-; DM 8,-
SZS-	**(German)**	
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TID-		
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22330(Vol.1)	20-10414	Dep. mn; CFSTI $4.00 cy, $2.25 mn
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TRG-Report-	**(British)**	
778	20-9989	J. Nucl. Energy. Pt. A and B, 19: 891-905(1965)
UCOL-	**(Misc.)**	
535-547	20-10020	Nucl. Phys., 77: 401-24(1966)
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7644	20-9130	Dep. mn. CFSTI $4.00 cy, $1.00 mn
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16500	20-9765	Phys. Rev. Lett., 16: 60-3(1966)
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875-93	20-9737	Phys. Lett., 19: 56-9(1965)
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546	20-9427	Dep. mn. CFSTI $2.00 cy, $0.50 mn
554	20-10486	Dep. mn. CFSTI $2.00 cy, $0.50 mn
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